

Thirteen Indicators of the Health of Michigan's Workforce

March 2006

*Michigan Department
of Community Health*



Jennifer M. Granholm, Governor
Janet Olszewski, Director

MICHIGAN STATE
UNIVERSITY

Thirteen Indicators of the Health of Michigan's Workforce

A Joint Report

of the

Michigan Department of Community Health
Bureau of Epidemiology
Division of Environmental and Occupational Epidemiology
201 Townsend Street
PO Box 30195
Lansing, Michigan 48909

and the

Michigan State University
Department of Medicine
Division of Occupational and Environmental Medicine
117 West Fee Hall
East Lansing, Michigan 48824

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State of Michigan
Governor – Jennifer M. Granholm

Michigan Department of Community Health
Director – Janet Olszewski
Acting Chief Medical Executive, Dean Sienko, MD, MS

Public Health Administration
Chief Administrative Officer – Jean Chabut, RN, MPH

Bureau of Epidemiology
Director – Corinne Miller, DDS, PhD

Authors
Thomas W. Largo, MPH – Bureau of Epidemiology, MDCH
Martha Stanbury, MSPH – Bureau of Epidemiology, MDCH
Kenneth Rosenman, MD – Michigan State University

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SUMMARY AND RECOMMENDATIONS

This report is the first examination of Michigan occupational health trends using nationally-developed indicators. The results can be used to prioritize health conditions for prevention efforts.

In 2001, a national panel of experts in occupational disease surveillance developed a set of nineteen occupational health indicators. These indicators are constructs of public health surveillance that define specific measures of health or risk status among specified populations. They can be used to track trends within a state and, in some cases, to compare states to each other or the nation.

The Council of State and Territorial Epidemiologists (CSTE) published a report in 2003 that provides step-by-step instructions for generating state-level indicator data. Subsequently, thirteen states applied these instructions to collect data for one year (2000) and CSTE published the results in an October 2005 report.

This step-by-step process was applied to develop trend data for Michigan for thirteen of the nineteen indicators. National trend data were also obtained for comparison for those indicators where these data were available. Data were sought spanning the period 1990-2003. For some indicators, data were unavailable for some years of this timeframe. The salient findings and related recommendations are noted below.

Findings

- Of the thirteen indicators, Michigan rates increased over time only for lung diseases (asbestosis and mesothelioma).
- Michigan rates consistently exceeded national rates for four conditions: non-fatal injuries and illnesses; amputations; carpal tunnel syndrome; and musculoskeletal disorders of the neck, shoulder, and upper extremities. These all were conditions reported by employers.
- Between 1992 and 2003, the national work-related injury death rate decreased 23%. During this period, Michigan rates showed no reduction.
- Between 1992 and 2002, national incidence rates of malignant mesothelioma decreased 17% while Michigan rates increased 26%.
- Asbestosis was the only form of pneumoconiosis for which Michigan rates increased. They increased 125% for asbestosis-related mortality (1990-2003) and 265% for hospitalizations from or with asbestosis (1990-2002).

Recommendations

Based on these findings, analyses should be conducted to address the following questions:

- Is there a particular cause of fatal injury for which national rates are substantially decreasing in comparison to Michigan rates? Are there specific demographic groups for which this is true?
- Why is mesothelioma incidence decreasing nationally, but increasing in Michigan?
- Are there particular industries and/or demographic groups that are responsible for Michigan rates of employer-reported musculoskeletal disorders and amputations to exceed national rates?

Results of these analyses may indicate opportunities for targeted interventions to reduce risk.

This report will be updated annually and made available on the websites of the Michigan Department of Community Health, Division of Environmental and Occupational Epidemiology, and the Michigan State University College of Human Medicine, Occupational and Environmental Medicine Division.

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Introduction

About 4.7 million people work in Michigan. Each year, thousands of these workers are injured on the job or become ill as a result of exposure to health hazards at work. These work-related injuries and illnesses result in substantial human and economic costs for workers, employers, and society at large. Workers' compensation claims alone cost nearly \$1.5 billion in 2003 in Michigan.¹

Work-related injuries and illnesses can be prevented. Successful approaches to making workplaces safer and healthier begin with having the data necessary to understand the problem. Public health surveillance data are needed to determine the magnitude of work-related injuries and illnesses, identify workers at greatest risk, and establish prevention priorities. Data are also necessary to measure the effectiveness of prevention activities, and to identify workplace health and safety problems that need further investigation.

In 2003, the Council of State and Territorial Epidemiologists (CSTE) published a report titled *Occupational Health Indicators: A Guide for Tracking Occupational Health Conditions and Their Determinants*, which details a core set of occupational health indicators identified and developed by a State-Federal Workgroup.² These indicators are a set of surveillance measures that allow states and territories to uniformly define, collect, and report occupational illness, injury, and risk data. They were selected because of their importance to public health and the availability of easily obtainable statewide data in most states. The document provided a step-by-step process for generating individual state indicator data. Then, in October 2005, CSTE published a report – *Putting Data to Work: Occupational Health Indicators from Thirteen Pilot States for 2000* – in which thirteen states applied the step-by-step process to generate one year of data (2000) for each indicator.³

In this report, the step-by-step process has been applied to develop trend data for Michigan for thirteen of the nineteen indicators described in the CSTE reports. National trend data are also presented for comparison for those indicators where these data are available. For each indicator, data was sought from 1990 until the most recent year available. Due to differences in data sources, the timeframes covered vary by indicator.

The report begins with demographic profiles of the state and national workforce. A description of the data sources used to generate the indicators, including significant data limitations, is provided in Appendix B. Data tables for each of the indicators are provided in Appendix A. This report will be updated annually and made available on websites of the Michigan Department of Community Health, Division of Environmental and Occupational Epidemiology, and the Michigan State University College of Human Medicine, Occupational and Environmental Medicine Division.

What is an Occupational Health Indicator?

An occupational health indicator is a specific measure of a work-related disease or injury, or a factor associated with occupational health, such as a workplace exposure, hazard, or intervention, in a specified population. Indicators can be used to track trends in the occupational health status of the working population and identify health conditions that warrant more in-depth investigation.

Employment Demographics

The national workforce has become more diverse. This diversity in age, race, ethnicity, and levels of employment in certain industries and occupations varies across the country. Differences in characteristics of Michigan workers and the United States workforce are important to consider when comparing health outcomes of the state to the nation.

Table 1 presents characteristics of the working population in Michigan and the U.S. in 2003. Michigan had a higher unemployment rate (7.3%) compared to the nation (6.0%). While most of the demographic characteristics were similar, individuals of Hispanic ethnicity comprised a lower proportion of Michigan workers (3.1% vs. 12.6%). Michigan had a greater proportion of workers employed part-time (21.0% vs. 17.7%). More than one-quarter of the state and national workforce worked more than 40 hours a week. One in eighteen workers (5.6%) in Michigan were self-employed in 2003. Neither the workers' compensation system nor the national surveillance system based on the U.S. Bureau of Labor Statistics (BLS) Annual Survey covers incidents of work-related injury and illness among the self-employed.

TABLE 1
Workforce Characteristics, Ages 16 and Older,
Michigan and United States, 2003

Characteristic	Michigan	United States
Number employed (in thousands)	4,674	137,736
% Workforce unemployed	7.3	6.0
% Male	52.7	53.2
% Female	47.3	46.8
% Ages 16-17	2.2	1.7
% Ages 18-64	95.0	95.0
% Ages 65 and older	2.8	3.3
% White	85.1	82.9
% Black	11.1	10.7
% Other	3.8	6.4
% Hispanic ethnicity	3.1	12.6
% Self-employed	5.6	7.5
% Employed part-time*	21.0	17.7
% Work < 40 hrs/week	37.3	33.6
% Work 40 hrs/week	35.8	39.6
% Work > 40 hrs/week	26.9	26.7

* "Employed part-time" are individuals who work 1 to 34 hours per week.

Data Sources: Michigan – Current Population Survey (age distribution only) and Geographic Profile of Employment and Unemployment. United States – Employment and Earnings, Bureau of Labor Statistics

Table 2 provides the distribution of the Michigan and national workforce by major industry classifications (North American Industry Classification System (NAICS) – based categories). The three primary industries in 2003 were manufacturing, education/health services, and wholesale/retail trade. The most notable difference between the Michigan and national workforces was the proportion of workers in the manufacturing industry (21.1% in Michigan; 12.3% U.S.). Farms with fewer than eleven employees and federal employees are excluded from the BLS Annual Survey.

TABLE 2
Distribution of Workforce by Major Industry Groups
Michigan and United States, 2003 Annual Averages

Industry	Michigan	United States
Number Employed (in thousands)	4,674	137,736
% Mining	0.1	0.4
% Construction	6.5	7.4
% Manufacturing	21.1	12.3
% Wholesale and retail trade	14.9	15.0
% Transportation and utilities	4.0	5.0
% Information	1.8	2.7
% Financial activities	5.0	7.1
% Professional and business services	8.8	10.1
% Education and health services	20.8	20.5
% Leisure and hospitality	8.4	8.4
% Other services	4.3	4.9
% Public administration	3.4	4.5
% Agriculture	1.0	1.7

Data Sources: Michigan – Geographic Profile of Employment and Unemployment. United States – Employment and Earnings, Bureau of Labor Statistics

Table 3 illustrates the distribution of state and national workers by major occupation classifications (according to the 2002 Census occupational classification system). There was less of a difference between the Michigan and the U.S. workforces for occupations as compared to industries. The largest difference was in production occupations (11.0% in Michigan vs. 7.0% U.S.)

TABLE 3
Distribution of Workforce by Major Occupation Groups
Michigan and United States, 2003 Annual Averages

Occupation	Michigan	United States
Number Employed (in thousands)	4,674	137,736
Management, business and financial operations	12.4	14.5
Professional and related occupations	19.9	20.3
Service	17.4	16.0
Sales and related occupations	10.5	11.6
Office and administrative support	13.9	14.2
Farming, fishing, and forestry	0.4	0.8
Construction and extraction	5.0	5.9
Installation, maintenance, and repair	3.3	3.7
Production	11.0	7.0
Transportation and material moving	6.1	6.0

Data Sources: Michigan – Geographic Profile of Employment and Unemployment. United States – Employment and Earnings, Bureau of Labor Statistics

Indicator 1: Non-fatal Injuries and Illnesses Reported by Employers

Work-related injuries are generally defined as injuries that result from single events such as falls, being struck or crushed by objects, electric shocks, or assaults. Work-related illnesses, such as asthma, silicosis, and carpal tunnel syndrome, typically occur as the result of longer-term exposure to hazardous chemicals, physical hazards (e.g., radiation, noise), or repeated stress or strain at work. Infectious diseases also can be caused by workplace exposures. Work-related illnesses are more difficult to track than acute injuries because many illnesses are multifactorial and can also be caused or aggravated by non-occupational factors. In addition, many work-related illnesses take a long time to develop and may not appear until many years after individuals have left employment.

The Bureau of Labor Statistics (BLS) Annual Survey of Occupational Injuries and Illnesses (Annual Survey) provides yearly estimates of the numbers and incidence rates of work-related injuries and illnesses at national and state levels. Information is collected from a nationwide sample of employers on all work-related injuries and illnesses that result in death, lost work time, medical treatment other than first aid, loss of consciousness, restriction of work activity, or transfer to another job.

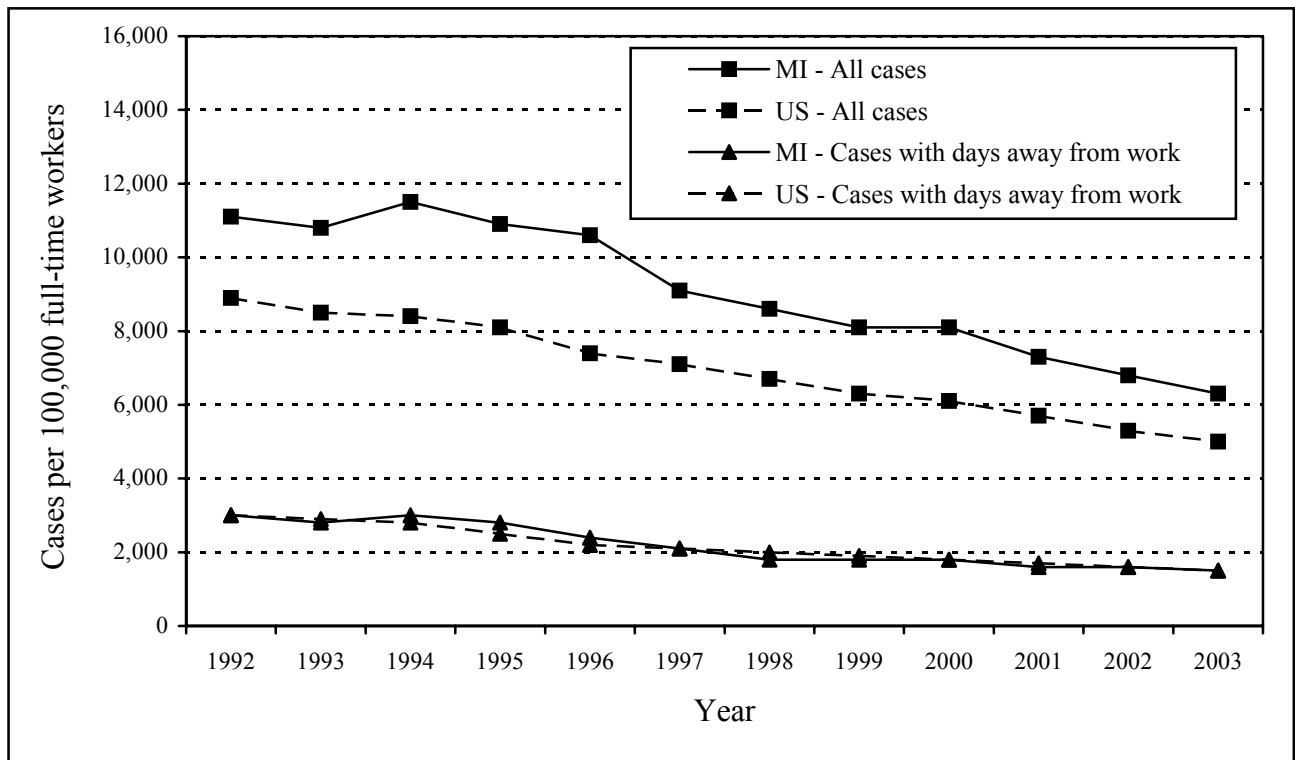
While the Annual Survey is a valuable source of information about work-related injuries and illnesses, it is well recognized that it has a number of limitations and underestimates the full extent of the problem. Excluded from national estimates are public sector workers, the self-employed, household workers, and workers on farms with fewer than eleven employees. Together these sectors comprise approximately 21% of the U.S. workforce.⁴ Occupational diseases are not well documented in the Annual Survey and there is evidence that injuries are underreported.^{5,6} It is also subject to sampling error. Additional data sources used in generating other Occupational Health Indicators in this report provide important supplementary information that provide a more complete picture of occupational health.

Figure 1 illustrates rates of non-fatal injuries and illnesses for Michigan and the United States for the period 1992-2003 according to BLS Annual Survey data. Michigan's rates for all cases consistently exceeded national rates by approximately two thousand cases per 100,000 full-time workers. In contrast, there was little difference between Michigan and national rates for cases involving days away from work.

Rates of reported injuries and illnesses declined during 1992-2003. For all cases, the rate decreased 43% in Michigan (from 11,100 to 6,300 cases per 100,000 full-time workers) and 44% nationally. For cases involving days away from work, the rate decreased by 50% both in Michigan and nationally (from 3,000 to 1,500 cases per 100,000 full-time workers).

The number of cases in Michigan and the U.S. are presented in Table 1.A of Appendix A. Included in this table are the number of cases resulting in more than ten days away from work. In Michigan during 1992-2003, 10% of cases resulted in more than ten lost workdays. Table 1.B of the Appendix contains rates for all cases and cases resulting in days away from work (note: BLS does not publish rates pertaining to cases with ten or more lost workdays.)

FIGURE 1
Rates of non-fatal work-related injuries and illnesses
reported by private sector employers, Michigan and United States, 1992-2003



Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

- The rates published by BLS are the number of injury and illness cases per 100 full-time workers. The rates illustrated here, which are cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 1,000. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

Indicator 2: Work-related Hospitalizations

Individuals hospitalized for work-related injuries and illnesses have some of the most serious and costly adverse work-related health conditions. It has been estimated that, nationwide, approximately three percent of workplace injuries and illnesses result in hospitalizations, and that hospital charges for work-related conditions exceed \$3 billion annually. Most work-related hospitalizations are for treatment of musculoskeletal disorders and acute injuries.⁷

Hospital discharge data are useful for surveillance of certain health conditions. While these data sets do not include explicit information about work-relatedness of the health conditions for which a patient is hospitalized, they do include information about the payer for the hospital stay. The designation of workers' compensation as primary payer is a good proxy for the work-relatedness of hospitalized injuries.⁸ It is not a useful measure of hospitalizations for work-related illnesses.

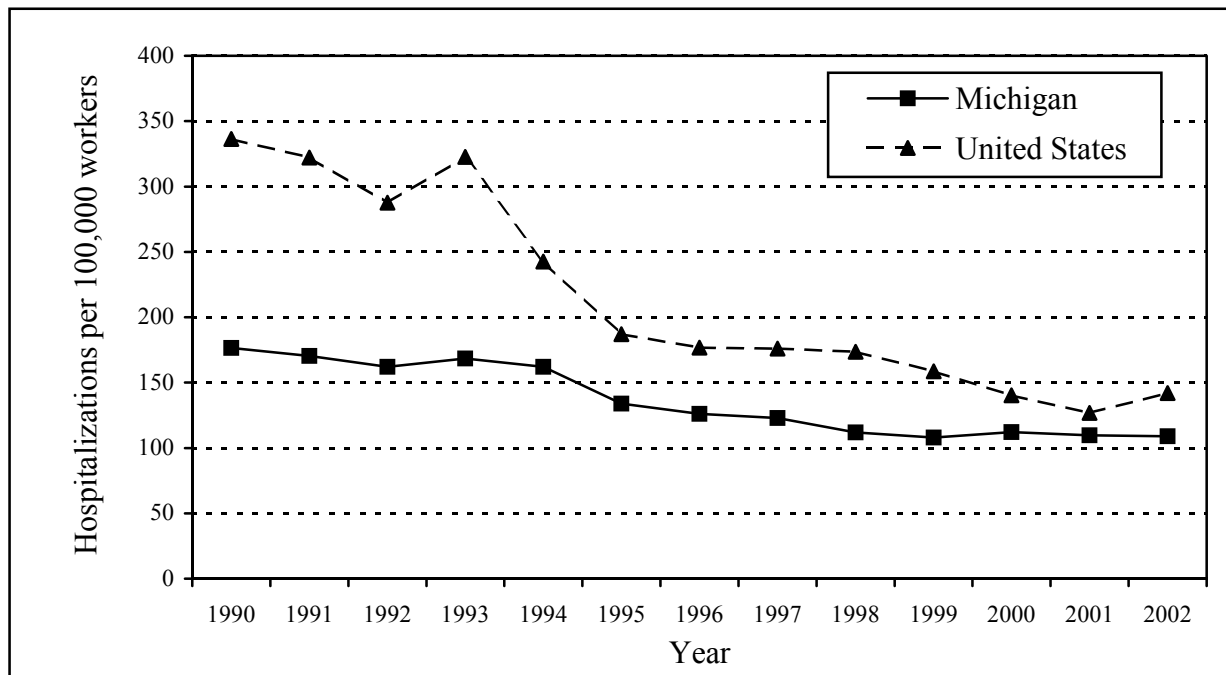
Figure 2 illustrates hospitalization rates by year for individuals with workers' compensation reported as the primary payer for Michigan and the United States during 1990-2002. For the entire period, national rates exceeded Michigan rates although the difference diminished dramatically starting in 1995. Michigan's rate decreased 38% from 1990 to 2002 (from 176.5 to 109.0 hospitalizations per 100,000 workers). However, from 1998 to 2002, rates remained fairly level. Table 2 in Appendix A provides the numbers and rates for Michigan and the U.S. for the 13-year period.

The sources of state and national data have important differences:

- Michigan data are based on a census of acute care hospitals, while national data are estimates derived from the National Hospital Discharge Survey. Because the Survey is conducted in a sample of hospitals, each annual estimate has an associated sampling error.
- Michigan data reflect state residents hospitalized in-state. This definition results in a slight undercount of Michigan resident hospitalizations. For example, in 2002, 2.7% of all Michigan resident work-related hospitalizations, as defined here, were at out-of-state hospitals.
- In 1996, the National Hospital Discharge Survey no longer “re-ordered” principal and additional sources of payment. (Re-ordering is the process by which a source originally listed as secondary is considered the primary payer.) This change could alter estimates causing a difference between pre- and post-1996 estimates of work-related hospitalizations (which rely on using Workers’ Compensation as payer source to find cases). The change would tend to decrease the number of cases identified as work-related (the degree of this reduction is unknown). Ascertainment of Michigan cases was consistent across the time period (only cases where workers’ compensation was listed as the primary payer were included).

- There are substantial differences among states in workers' compensation eligibility, reimbursement, and other administrative policies. Thus, differences between Michigan and the U.S. in work-related hospitalization rates as defined in this indicator reflect variations in both workers' compensation systems and the incidence of work-related injuries and illnesses resulting in hospitalization.

FIGURE 2
Rate of work-related hospitalizations
Michigan and United States, 1990-2002



Data sources: Numbers of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Employment statistics used to calculate rates: Michigan – BLS Geographic Profile of Employment and Unemployment; United States – BLS Employment and Earnings.

Technical Notes:

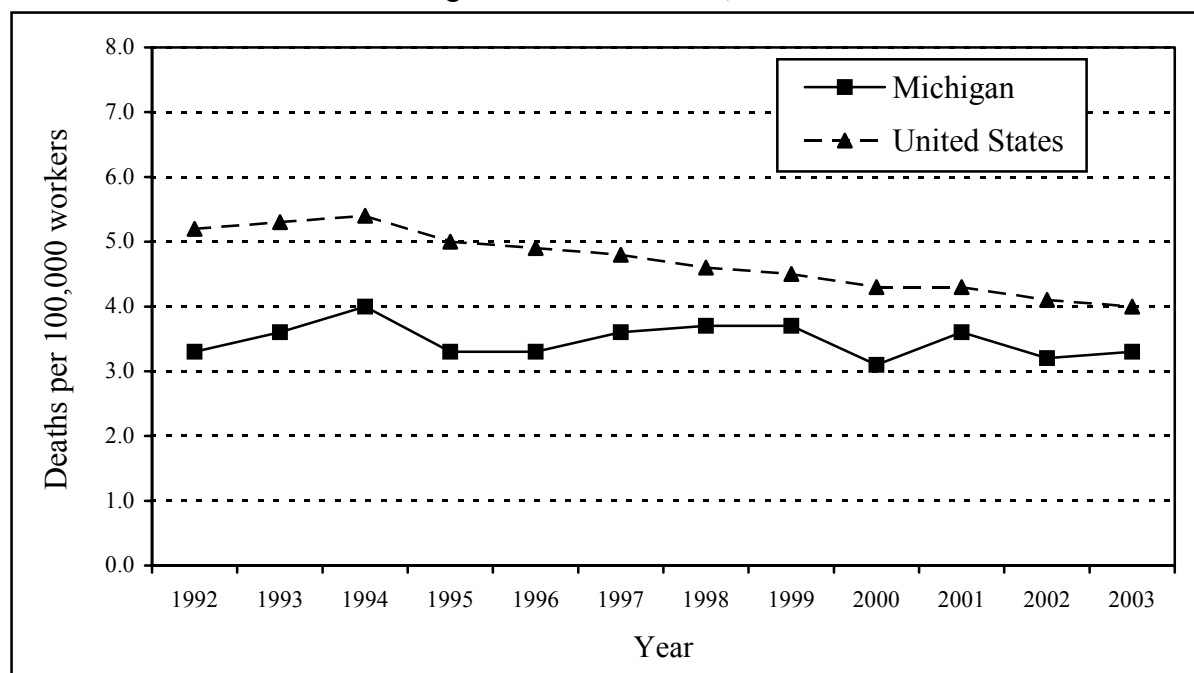
- Hospital discharge records are limited to records from non-federal, acute care hospitals.
- Some workers are hospitalized more than once for injuries or illnesses related to a given incident or exposure. Due to data limitations, these secondary hospitalizations cannot be excluded. Thus, this indicator is a measure of hospitalization incidence, not injury/illness incidence.
- Michigan cases were ascertained by searching all available diagnoses for each patient. National data were limited to searching the first seven listed diagnoses. Since most patients have seven or fewer diagnoses (e.g., 83% in Michigan in 2003), however, the undercount of national cases is likely minimal.

Indicator 3: Fatal Work-related Injuries

A fatal work-related injury is an injury occurring at work that results in death. Since 1992 the Bureau of Labor Statistics (BLS) has conducted the Census of Fatal Occupational Injuries (CFOI), using multiple data sources to provide complete counts of all fatal work-related injuries in the nation and in every state. CFOI includes fatalities resulting from unintentional injuries such as falls, electrocutions, acute poisonings, and motor vehicle crashes that occurred during travel for work. It counts the death in the state where the event occurred, not where the death occurred. Also included are intentional injuries (i.e., homicides and suicides) that occurred at work. Fatalities that occur during a person's commute to or from work are not counted.

Between 1992 and 2003, the national work-related injury fatality rate declined 23%. The rate for Michigan, while consistently lower than the national rate, had virtually no reduction during this time period (Figure 3). Table 3 in Appendix A provides the number and rates of deaths each year for the U.S. and Michigan.

FIGURE 3
Rate of fatal work-related injuries
Michigan and United States, 1992-2003



Data sources: Numbers of fatalities: Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries. Employment statistics used to calculate rates: BLS Current Population Survey.

Technical Notes:

- The population data used to calculate rates are Michigan residents while the count of cases includes out-of-state residents fatally injured in Michigan and excludes Michigan residents fatally injured out of state. Thus, Michigan rates may not represent the true resident death rate.
- Workers younger than age 16 and the military are included in the numerators of rates, whereas the employment statistics used to calculate rates excluded these groups. This may result in a slight overestimation of rates.
- The rates listed here may differ slightly from those published by BLS for the following reasons: BLS excludes those under age 16 and the military in calculating state rates; BLS excludes deaths of workers under age 16 and the military in both the numerator and denominator in calculating national rates.

Indicator 4: Work-related Amputations with Days Away from Work Reported by Employers

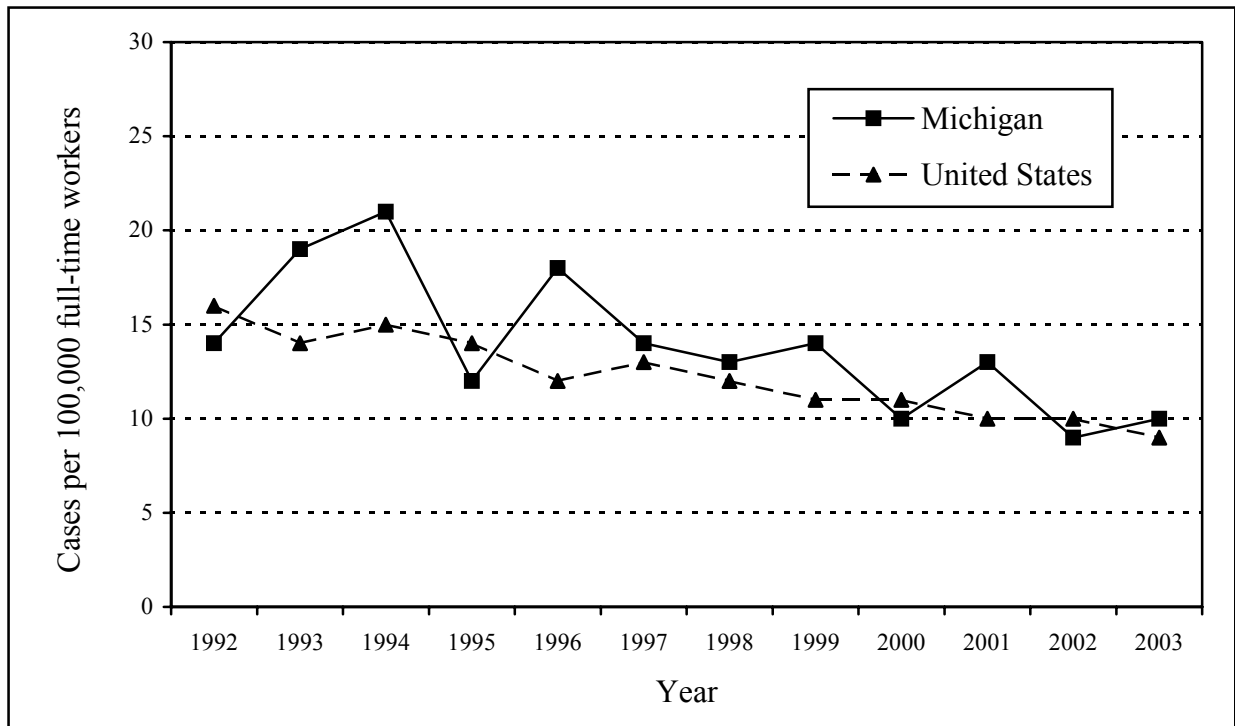
An amputation is defined as full or partial loss of a protruding body part – an arm, hand, finger, leg, foot, toe, ear, or nose. An amputation may greatly reduce a worker's job skills and earning potential as well as significantly affect general quality of life.

The Bureau of Labor Statistics (BLS) Annual Survey of Occupational Injuries and Illnesses (Annual Survey) provides yearly state and national estimates of the numbers and incidence rates of work-related amputations that involve at least one day away from work. According to the Annual Survey, nationally in 2003 there were 8,150 workers in private industry who sustained amputations that resulted in days lost from work. Ninety-six percent (96%) of these amputations involved fingers. The median number of lost work days was 30 for amputation cases compared to eight days for all work-related injuries and illnesses.

Figure 4 illustrates the estimated rates of work-related amputations in private industry for Michigan and the United States for the period 1992-2003. For a majority of these years, Michigan's rates exceeded national rates. Michigan's amputation rate declined from 14 to 10 cases per 100,000 full-time workers, a 29% reduction, over this time period. The estimated numbers and rates are provided in Table 4 in Appendix A.

While the Annual Survey is a valuable source of information about work-related injuries, it has a number of limitations. Excluded from national estimates are public sector workers, the self-employed, household workers, and workers on farms with fewer than eleven employees. Together, these sectors comprise approximately 21% of the U.S. workforce.⁴ A study in Michigan estimated that the Annual Survey identified only 64% of all work-related amputations.⁹ State workers' compensation data used in Indicator 5 are another source of information about work-related amputations.

FIGURE 4
 Rate of nonfatal work-related amputations with days away from work
 reported by private sector employers, Michigan and United States, 1992-2003



Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

- The rates published by BLS are the number of injury and illness cases per 10,000 full-time workers. The rates presented here, which are cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

Indicator 5: Amputations Identified in the Workers' Compensation System

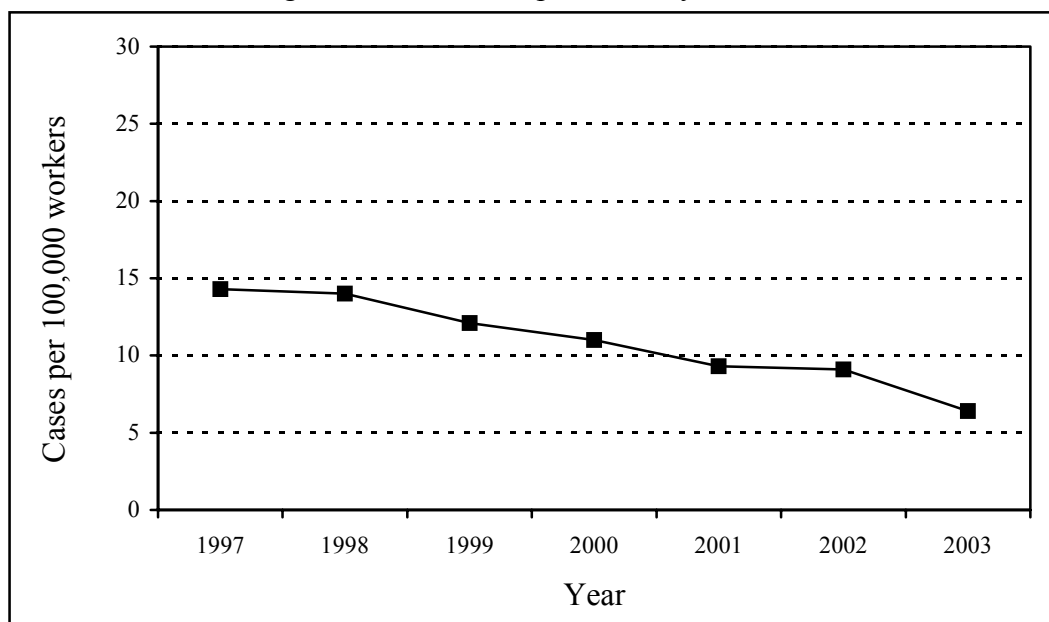
Claims data from Michigan's workers' compensation system were used as another source, in addition to the BLS Annual Survey (see Indicator 4), of data on work-related amputations. Cases were limited to claims resulting in wage compensation. These are claims involving specific losses (amputation of fingers, hands, arms, toes, feet, legs) or amputations resulting in a disability for more than seven consecutive days (e.g., amputation of ear). The first year of available data was 1997. One study found that claims data missed at least 11% of work-related amputations in Michigan.⁹

Figure 5 illustrates the annual rates of amputation claims identified in the Michigan workers' compensation system for the period 1997-2003. (There are no national data on workers' compensation claims to use as a comparison.) Table 5 in Appendix A contains the annual numbers and rates. Amputation rates declined consistently over the seven-year period. Overall, the rate declined 55% from 1997 to 2003.

Comparison to Indicator 4

The average annual number of amputations identified via workers' compensation claims was 26% greater than the average annual number identified via employer reports (Indicator 4) between 1997 and 2003 (465 and 370, respectively). Some of this difference is likely due to differences in case definitions. BLS requires at least one day lost from work while workers' compensation has no requirement on the amount of work lost for most amputations. The average annual amputation rates during this period were comparable, with the rate per BLS actually exceeding the workers' compensation rate (11.9 vs. 10.9 per 100,000 workers). According to both data sources, work-related amputation rates decreased over this time period. This decline was more substantial per workers' compensation (55%) than BLS (29%), however, this difference was due to the significant decrease in workers' compensation cases in 2003. Between 1997 and 2002, the two data sources measured equivalent decreases in rates.

FIGURE 5
Rate of lost wage claims for amputations identified in
Michigan's workers' compensation system, 1997-2003



Data sources: Numbers of amputations: Michigan Department of Labor and Economic Growth, Workers' Compensation Agency. Numbers of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

Indicator 6: Hospitalizations for Work-Related Burns

Burns encompass injuries to tissues caused by contact with dry heat (fire), moist heat (steam), chemicals, electricity, friction, or radiation. Burns are among the most expensive work-related injuries to treat and can result in significant disability. Thermal and chemical burns are the most frequent types of work-related burn injury. A substantial proportion of burns occur in the service industry, especially in food service, often disproportionately affecting working adolescents.^{10,11}

According to the Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses, in the United States in 2002, there were an estimated 31,000 burn injuries resulting in days away from work (private sector), for an incidence rate of 3.6 per 10,000 full-time workers. Nationally in 2001, an estimated 101,000 people with work-related burns were treated in an emergency department. * Approximately 30% to 40% of hospitalizations for burns among adults have been found to be work-related.¹¹

Hospital discharge data are useful for surveillance of work-related burns. While these data sets do not include explicit information about work-relatedness of incidents, they do include information about the payer for the hospital stay. The designation of workers' compensation as primary payer is a good proxy for the work-relatedness of hospitalized injuries.⁸

Figure 6 shows burn hospitalization rates by year for individuals with workers' compensation reported as the primary payer for Michigan and the United States during 1990-2002 (national rates are not presented for four years in which the estimate was considered too statistically unstable for publication). For the entire period, national rates exceeded Michigan rates. The Michigan rate decreased from 3.7 to 1.9 hospitalizations per 100,000 workers, nearly a 50% reduction over the 13-year period. However, this reduction mostly had occurred by 1993; thereafter, Michigan's rates decreased very little. For the nine years of available data, the national trend was similar to Michigan's. Table 6 in Appendix A provides the numbers and rates for Michigan and the U.S. for the 13-year period.

The sources of state and national data have differences which may limit their comparability:

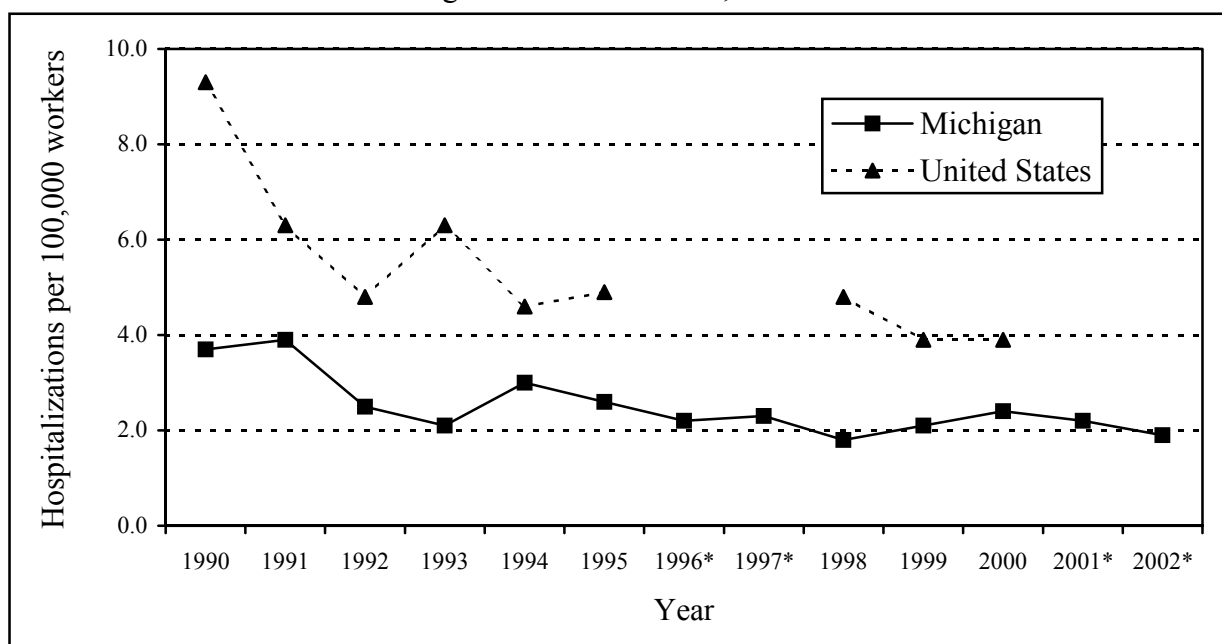
- Michigan data are based on a census of acute care hospitals, while national data are estimates derived from the National Hospital Discharge Survey. Because the Survey is conducted in a sample of hospitals, each annual estimate has an associated sampling error.
- Michigan data reflect state residents hospitalized in-state. This definition results in a slight undercount of Michigan resident hospitalizations: an examination of work-related injury hospitalizations for several of the years during this time period indicates that about one to two percent of state residents are hospitalized out-of-state.
- In 1996, the National Hospital Discharge Survey no longer "re-ordered" principal and additional sources of payment. (Re-ordering is the process by which a source originally listed as secondary is considered the primary payer.) This change could alter estimates causing a difference between pre- and post-1996 estimates of work-related

* Based on an analysis by MDCH staff of a public use dataset from the 2001 National Hospital Ambulatory Medical Care Survey.

hospitalizations (which rely on using Workers' Compensation as payer source to find cases). The change would tend to decrease the number of cases identified as work-related (the degree of this reduction is unknown). Ascertainment of Michigan cases was consistent across the time period (only cases where workers' compensation was listed as the primary payer were included).

- There are substantial differences among states in workers' compensation eligibility, reimbursement, and other administrative policies. Thus, differences between Michigan and the U.S. in work-related hospitalization rates as defined in this indicator reflect variations in both workers' compensation systems and the incidence of work-related injuries and illnesses resulting in hospitalization.

FIGURE 6
Rate of hospitalizations for work-related burns
Michigan and United States, 1990-2002



* National estimate not presented for 1996, 1997, 2001, 2002 due to statistical instability.

Data sources: Numbers of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Employment statistics used to calculate rates: Michigan – BLS Geographic Profile of Employment and Unemployment; United States – BLS Employment and Earnings.

Technical Notes:

- Hospital discharge records are limited to records from non-federal, acute care hospitals.
- A burn hospitalization is defined as a hospital discharge with a principal diagnosis in the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)³⁹ code range 940-949.
- Some workers are hospitalized more than once for injuries related to a given incident. Due to data limitations, these secondary hospitalizations cannot be excluded. Thus, this indicator is a measure of hospitalizations, not burn injuries.
- Michigan cases were ascertained by searching all available diagnoses for each patient. National data were limited to searching the first seven listed diagnoses. Since most patients have seven or fewer diagnoses (e.g., 83% in Michigan in 2003), however, the undercount of national cases is likely minimal.

Indicator 7: Musculoskeletal Disorders Reported by Employers

Work-related musculoskeletal disorders (MSDs) are injuries or disorders of muscles, tendons, nerves, ligaments, joints, or spinal discs that are caused or aggravated by work activities. Workplace risk factors for MSDs include repetitive forceful motions, awkward postures, use of vibrating tools or equipment, and manual handling of heavy, awkward loads.

This occupational health indicator is based on data collected by the Bureau of Labor Statistics (BLS) in the Annual Survey of Occupational Injuries and Illnesses (Annual Survey). The BLS definition of MSDs includes sprains, strains, pain, hurt back, carpal tunnel syndrome, and hernia in which the event leading to the condition is reported as overexertion, repetitive motion, or bending, reaching, twisting, climbing, or crawling. The definition excludes MSDs reportedly caused by single events such as slips and falls, and motor vehicle crashes.

MSDs are some of the most common and costly work-related health problems. These injuries can significantly impact the ability of workers to perform their jobs and affect quality of life both on and off the job. According to the Annual Survey, MSDs have consistently accounted for over one-third of all work-related injuries and illnesses involving days away from work reported by employers over the last decade.¹² In 2003, BLS estimated that, nationwide, there were over 435,000 work-related MSDs resulting in days away from work (private sector) for an annual rate of 496 cases per 100,000 full-time workers. Direct workers' compensation costs of work-related MSDs have been estimated at \$20 billion annually in the U.S., and total costs of these injuries when including indirect costs, such as lost productivity, range as high as \$54 billion.¹³

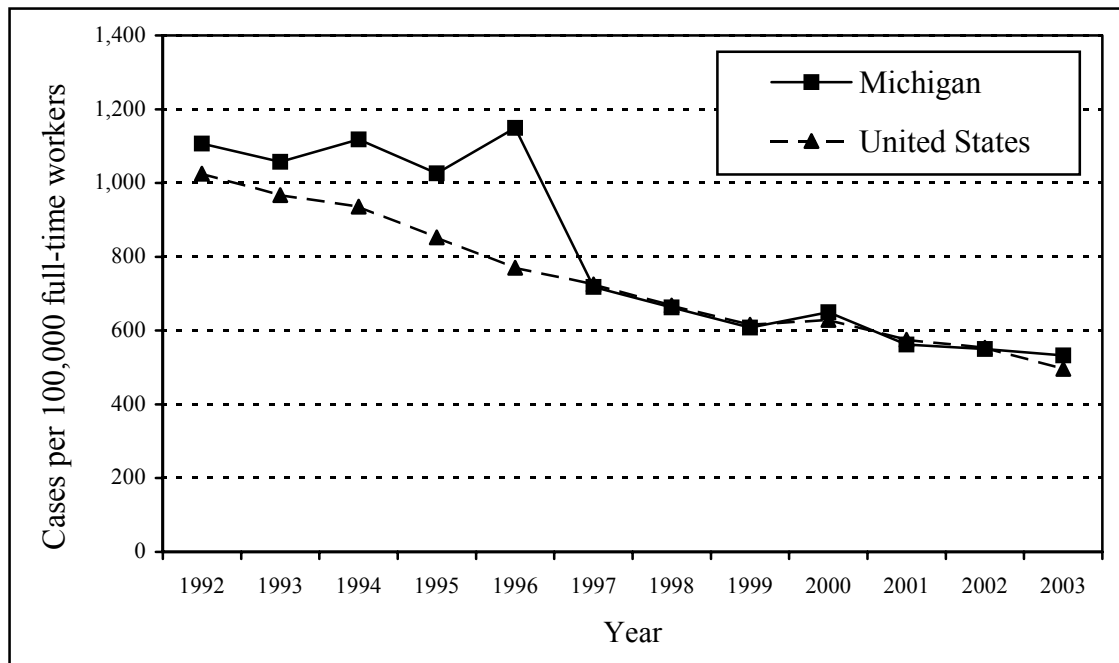
Figure 7.A illustrates the estimated rates of all work-related MSDs resulting in days away from work for Michigan and the U.S. during 1992-2003. Rates decreased substantially over this time period. In Michigan, the rate dropped 52% from 1,107 to 533 cases per 100,000 full-time workers. Between 1992 and 1996, Michigan rates exceeded national rates; thereafter, the rates were very similar.

Figure 7.B illustrates the estimated rates of one form of MSD, carpal tunnel syndrome. As with overall MSDs, rates decreased over time (by 25% in Michigan). In contrast to what was found for all MSDs, Michigan rates exceeded national rates throughout the entire twelve-year period (by an average of 48% annually). Workers' compensation data used in Indicator 8 in this report provide additional information about carpal tunnel syndrome.

Numbers and rates for selected types of MSDs for Michigan and the U.S. for 1992-2003 are presented in Appendix A in Tables 7.A and 7.B, respectively. The selected types include: neck, shoulder, and upper extremity; carpal tunnel syndrome; and back. For most years, MSDs of the back account for about half of the total MSDs reported.

The Annual Survey is based on data collected from a nationwide sample of employers. While it is a valuable source of information about work-related injuries, it has a number of limitations. Excluded from national estimates based on the Annual Survey are public sector workers, the self-employed, household workers and workers on farms with fewer than 11 employees. Together these sectors comprise approximately 21% of the U.S. workforce.⁴ In addition, there is evidence that MSDs are under-recorded on the Occupational Safety and Health Administration (OSHA) logs that serve as the basis for the Annual Survey.^{5,6} The Annual Survey is also subject to sampling error.

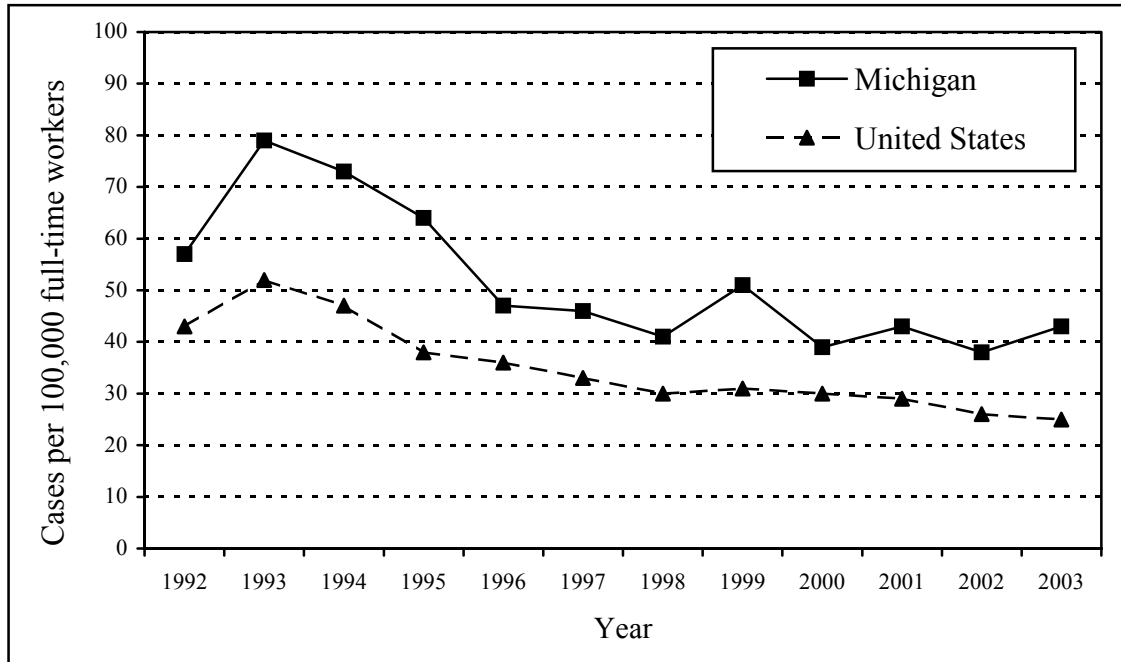
FIGURE 7.A
Rates of all work-related musculoskeletal disorders* involving days away from work reported by private sector employers, Michigan and United States, 1992-2003



* Defined as one of the following conditions resulting from overexertion, repetitive motion, or bending/climbing/crawling/reaching/twisting: sprains, strains, tears; back pain, hurt back; soreness, pain, hurt except the back; carpal tunnel syndrome; hernia; or musculoskeletal system and connective tissue diseases and disorders.

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

FIGURE 7.B
Rates of carpal tunnel syndrome* involving days away from work
reported by private sector employers, Michigan and United States, 1992-2003



* Defined as being due to overexertion, repetitive motion, or bending/climbing/crawling/reaching/twisting.
Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical Note:

- The rates published by BLS are the number of MSD cases per 10,000 full-time workers. The rates presented here, which are MSD cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

Indicator 8: Carpal Tunnel Syndrome Cases Identified in the Workers' Compensation System

Carpal tunnel syndrome (CTS) occurs when the median nerve is compressed at the wrist. Symptoms range from a burning, tingling, or numbness in the fingers to difficulty gripping or holding objects. Workplace factors that may cause or aggravate CTS include direct trauma, repetitive forceful motions or awkward postures of the hands, and use of vibrating tools or equipment.¹⁴

CTS has the longest average disability duration among the top ten workers' compensation conditions in the United States.¹⁵ According to the Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses (Annual Survey), there were an estimated 22,110 lost workday cases of CTS in the private sector nationwide in 2003. The corresponding incidence rate was 2.5 per 10,000 full-time workers. The average number of days away from work due to CTS was 32.

Claims data from workers' compensation provide an independent, supplemental source of information about this form of musculoskeletal disorder, as compared to Indicator #7 which is based on Annual Survey data. For this indicator, cases were limited to claims resulting in wage compensation (incidents resulting in a disability for more than seven consecutive days). The first year of available data was 1997.

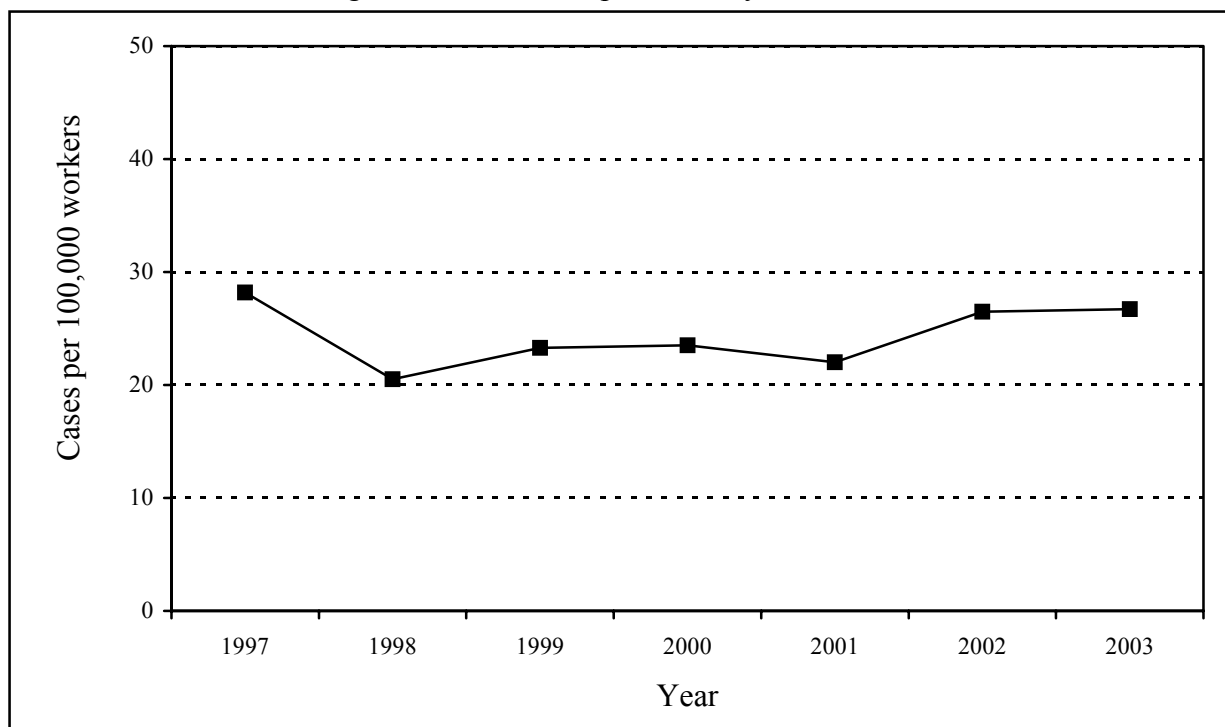
Figure 8 illustrates the annual rates of carpal tunnel syndrome claims identified in the Michigan workers' compensation system for the period 1997-2003. (There are no national data on workers' compensation claims to use for comparison.) Table 8 in Appendix A contains the annual numbers and rates. There was no clear trend in rates over this seven-year period. After a substantial reduction in the rate between 1997 and 1998, rates generally increased through 2003.

Comparison to Indicator 7

The average annual number of CTS cases reported by employers (Indicator 7) was 31% greater than the average annual number identified via workers' compensation claims between 1997 and 2003 (1,362 and 1,040, respectively). There was an even larger discrepancy between the average annual rates per BLS and workers' compensation (43.0 vs. 24.4 per 100,000 workers, a 76% difference). The trends demonstrated by data from each source were very similar. Per BLS, the CTS rate decreased 6.5% between 1997 and 2003; per workers' compensation, it decreased 5.3%.

Differences in case definitions may partially explain the differences in the number of cases identified by each system. In a BLS case, the worker must have lost at least one day from work as a result of the condition. In a workers' compensation case, the worker must have missed more than seven consecutive days.

FIGURE 8
Rate of lost work time claims for carpal tunnel syndrome cases identified in
Michigan's workers' compensation system, 1997-2003



Data sources: Number of CTS cases: State workers' compensation systems. Number of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

Indicator 9: Pneumoconiosis Hospitalizations

Pneumoconiosis is a term for a class of non-malignant lung diseases caused by inhaling mineral dust, nearly always in occupational settings. Most cases of pneumoconiosis develop only after many years of cumulative exposure; thus they are usually diagnosed in older individuals, long after the onset of exposure. These diseases are incurable and may ultimately result in death.¹⁶

Pneumoconiosis includes: silicosis, asbestosis, coal workers' pneumoconiosis (CWP), and, less commonly, pneumoconiosis due to a variety of other mineral dusts, including talc, aluminum, bauxite, and graphite. Byssinosis and several other dust-related lung diseases are sometimes grouped with "pneumoconiosis," even though they are caused by occupational exposure to organic (e.g., cotton) dust. Individuals with certain kinds of pneumoconiosis are at increased risk of other diseases, including cancer, tuberculosis, autoimmune conditions, and chronic renal failure.

State-based hospital discharge data are a useful population-based data source for quantifying pneumoconiosis even though only a small number of individuals with pneumoconiosis are hospitalized for that condition. In contrast, it is widely recognized that the Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses (Annual Survey) identifies very few cases of pneumoconiosis and other long latency diseases. For example, the Annual Survey estimated that in 2000, there were 70 pneumoconiosis cases in private industry nationwide, while there were 31,755 pneumoconiosis hospital discharges that year. Thus, hospital discharge data are an important source for quantifying the burden of pneumoconiosis, even though they capture only hospitalized cases.

Between 1990 and 2002, the age standardized hospitalization rate for pneumoconiosis among Michigan residents aged 15 and older increased 51%, from 71.2 to 107.2 per million residents (Table 9.A in Appendix A). The increase can be attributed to asbestosis: the asbestosis hospitalization rate increased 265% while coal workers' pneumoconiosis, silicosis and other/unspecified pneumoconioses all decreased during this time period (by 40%, 4%, and 49%, respectively). (See Tables 9.B-9.E in Appendix A.)

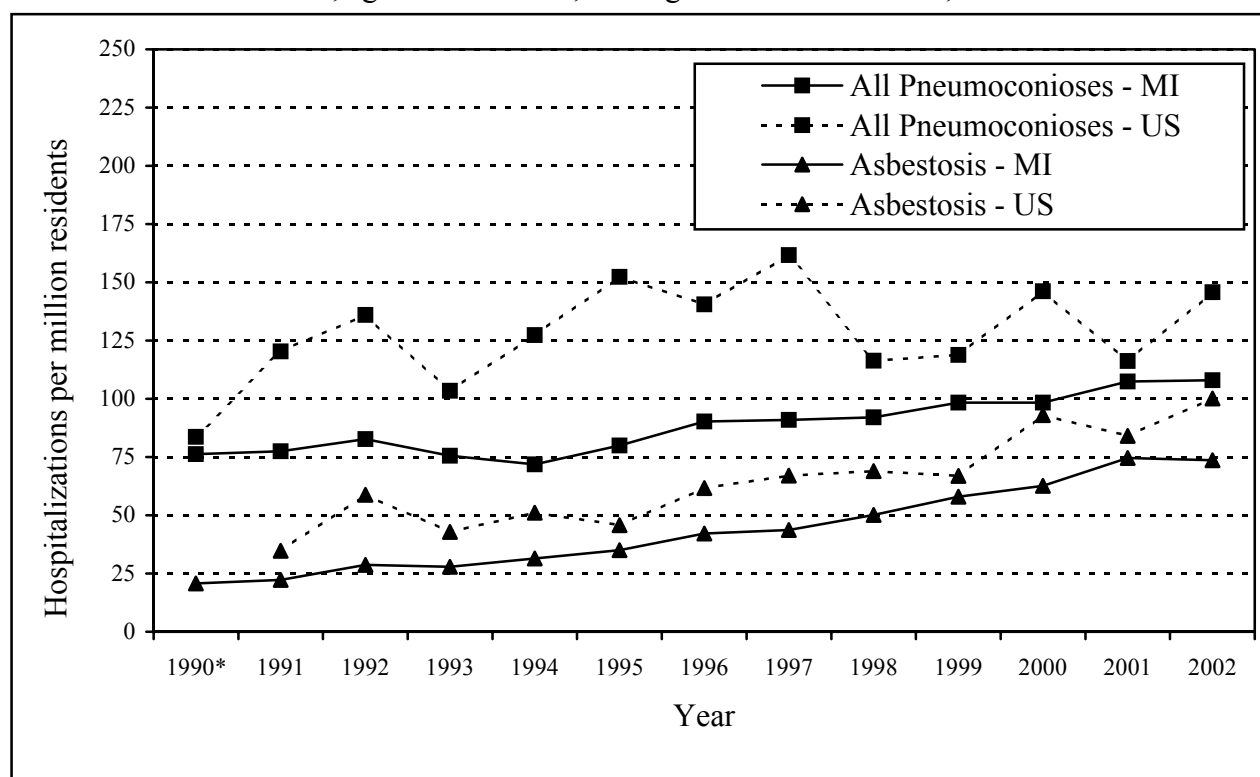
The increase in hospitalization rates for asbestosis and pneumoconiosis overall occurred nationally as well (Figure 9). Throughout the 13-year period, national rates exceeded Michigan's rates for overall pneumoconiosis, asbestosis, and coal workers' pneumoconiosis. (See Tables 9.A-9.C in Appendix A for comparative national data.) Age-standardized rates are used to compare Michigan to the United States because age-standardization removes the effect of differing age distributions. Due to statistical instability of national estimates of silicosis, no state-national comparison of this type of pneumoconiosis can be made.

The sources of state and national data have differences which may limit their comparability:

- Michigan data are based on a census of acute care hospitals, while national data are estimates derived from the National Hospital Discharge Survey. Because the Survey is conducted in a sample of hospitals, each annual estimate has an associated sampling error.

- Michigan data reflect state residents hospitalized in-state. This definition results in a slight undercount of Michigan resident hospitalizations. For example, in 2002, 1.7% of all Michigan resident hospitalizations from or with pneumoconiosis were at out-of-state hospitals.

FIGURE 9
Age-standardized rates of hospitalization from or with any form of pneumoconiosis and asbestosis, ages 15 and older, Michigan and United States, 1990-2002



* National estimate of asbestosis for 1990 not presented due to statistical instability.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: United States Census Bureau.

Technical Notes:

- Hospital discharge records are limited to records from non-federal, acute care hospitals.
- A pneumoconiosis case is defined as a hospital discharge with a principal or secondary diagnosis in the ICD-9-CM³⁹ code range 500-505. An asbestosis case is defined as a hospital discharge with a principal or secondary diagnosis with the ICD-9-CM code 501.
- Some workers are hospitalized more than once for pneumoconiosis. Due to data limitations, these secondary hospitalizations cannot be excluded. Thus, this indicator is a measure of hospitalizations for pneumoconiosis, not of individuals with pneumoconiosis.
- Michigan cases were ascertained by searching all available diagnoses for each patient. National data were limited to searching the first seven listed diagnoses. Since most patients have seven or fewer diagnoses (e.g., 83% in Michigan in 2003), however, the undercount of national cases is likely minimal.

Indicator 10: Pneumoconiosis Mortality

All states collect cause-of-death information on death certificates, including both the underlying and contributing causes of death. From 1990 through 1999, pneumoconiosis (for a definition of pneumoconiosis, see page 21) was an underlying or contributing cause of more than 30,000 deaths in the United States, for an overall age-adjusted annual mortality rate of 15.8 per million population among those age 15 and older. Pneumoconiosis was the underlying cause of death in approximately one-third of these deaths. The mortality rate from most kinds of pneumoconiosis has gradually declined since 1972 with the exception of asbestosis, which has increased by about 500%.¹⁷

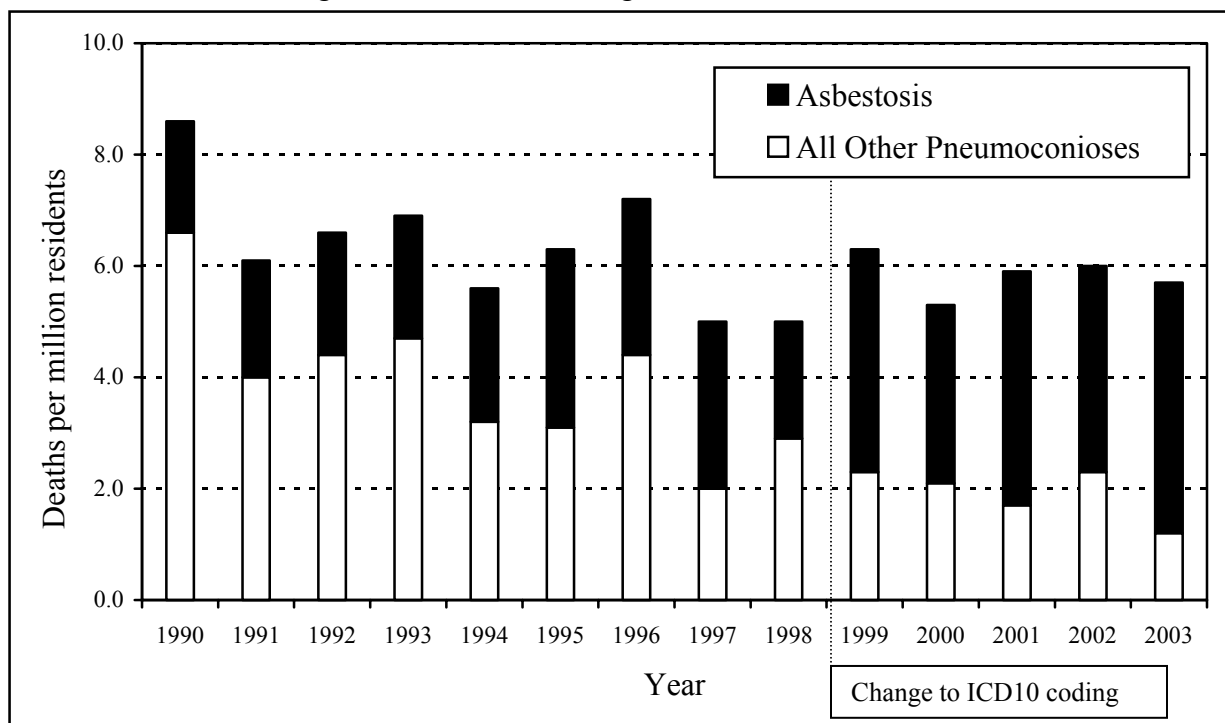
Deaths due to pneumoconiosis are undercounted on death certificates.^{18,19} Pneumoconiosis is likely to be under-recorded on the death certificate as a cause of death because it is under-recognized by clinicians for a number of reasons, including the long latency between exposure and onset of symptoms, and the non-specificity of symptoms.

Figure 10.A illustrates the annual age-adjusted rates for all pneumoconiosis deaths and for asbestosis deaths among Michigan residents aged 15 and older during the period 1990-2003. The rate for all pneumoconioses was highest in 1990 (8.6 deaths per million residents) and had declined by 34% by 2003. This decrease would have been more substantial if not for the increase in asbestosis deaths. The rate for asbestosis deaths increased 125% from 1990 to 2003 (from 2.0 to 4.5 deaths per million residents). Deaths from or with asbestosis accounted for 23% of the pneumoconiosis death rate in 1990. They comprised 79% of the rate in 2003.

Figure 10.B compares Michigan and U.S. death rates for all pneumoconiosis and asbestosis during 1990-2003. The Michigan and U.S. trends had the same pattern: a decreasing rate for all pneumoconioses, but an increasing rate for asbestosis. National rates were consistently higher than Michigan rates – generally two or three times greater for all pneumoconioses and slightly less than this magnitude for asbestosis.

The annual number of deaths and death rates for all types of pneumoconiosis for Michigan and the U.S. are presented in Table 10.A and Table 10.B, respectively, in Appendix A.

FIGURE 10.A
Age-standardized mortality rates from or with all pneumoconioses and asbestosis,
ages 15 and older, Michigan residents, 1990-2003

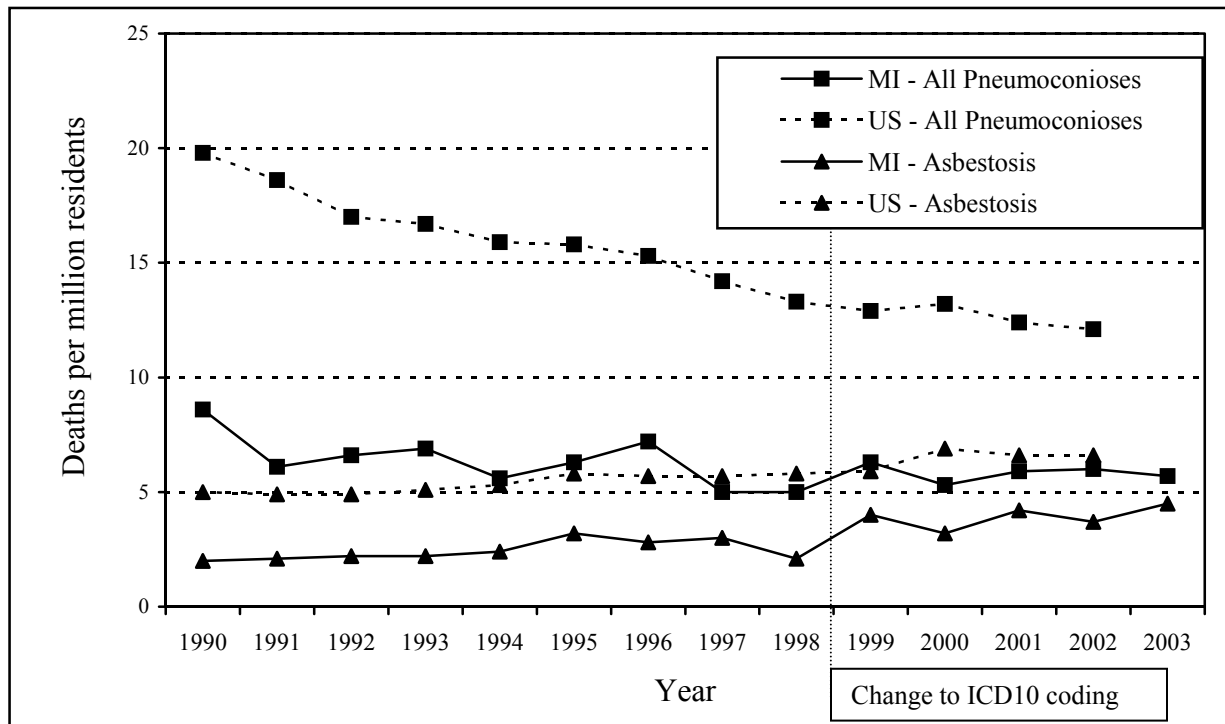


Data Sources: Numbers of deaths from or with pneumoconiosis: Vital Records and Health Data Development Section, Michigan Department of Community Health. Number of residents used to calculate rates: Population Division, United States Census Bureau.

Technical Notes:

See Technical Notes on page 25.

FIGURE 10.B
Age-standardized mortality rates from or with all pneumoconioses and asbestosis,
ages 15 and older, Michigan and United States, 1990-2003



Data Sources: Numbers of deaths from or with pneumoconiosis - Michigan: Vital Records and Health Data Development Section, Michigan Department of Community Health. Number of residents used to calculate rates - Michigan: Population Division, United States Census Bureau. Age-adjusted rates - United States: National Surveillance System for Pneumoconiosis Mortality, National Institute for Occupational Safety and Health.

Technical Notes:

- ICD10³⁶ coding of mortality was implemented in 1999. From 1979 to 1998, mortality coding utilized ICD9.⁴¹ This change from one coding system to another can affect enumeration of causes of death. For pneumoconiosis, the comparability ratio²⁰ is estimated at 1.0178, meaning that the change in coding systems by itself inflates counts of post-1998 pneumoconiosis deaths by 1.0178, or 1.78%. No information is available on the comparability ratios for various forms of pneumoconiosis such as asbestosis.
- For 1990-1998, a pneumoconiosis case was defined as a death with the underlying or contributing cause coded in the ICD9 range 500-505. Asbestosis was defined as a death coded with ICD9 501.
- For 1999-2003, a pneumoconiosis case was defined as a death with the underlying or contributing cause coded in the ICD10 range J60-J66. Asbestosis was defined as a death coded with ICD10 J61.

Indicator 11: Acute Work-related Pesticide Associated Illness and Injury Reported to Poison Control Centers

A pesticide is a substance or mixture of substances used to prevent or control undesired insects, plants, animals, or fungi. In the U.S., approximately one billion pounds of pesticides are used annually, contained in more than 16,000 pesticide products.²¹ Although the value of pesticides in protecting the food supply and controlling disease vectors is well recognized, it is also recognized that pesticides can cause harm to people and the environment. Adverse health effects from exposure vary depending on the amount and route of exposure and the type of chemical used. Agricultural workers and pesticide applicators are at greatest risk for the more severe pesticide poisonings.

The U.S. Environmental Protection Agency (EPA) estimates that there are 20,000 to 40,000 physician-treated work-related pesticide poisonings per year.²² National estimates of pesticide poisoning are not available from the Bureau of Labor Statistics. Poison Control Center (PCC) data are useful for monitoring pesticide poisonings nationally because PCCs service almost the entire U.S. population, even though calls to state and regional PCCs are estimated to capture only about 10% of acute occupational pesticide-related illness cases.²³

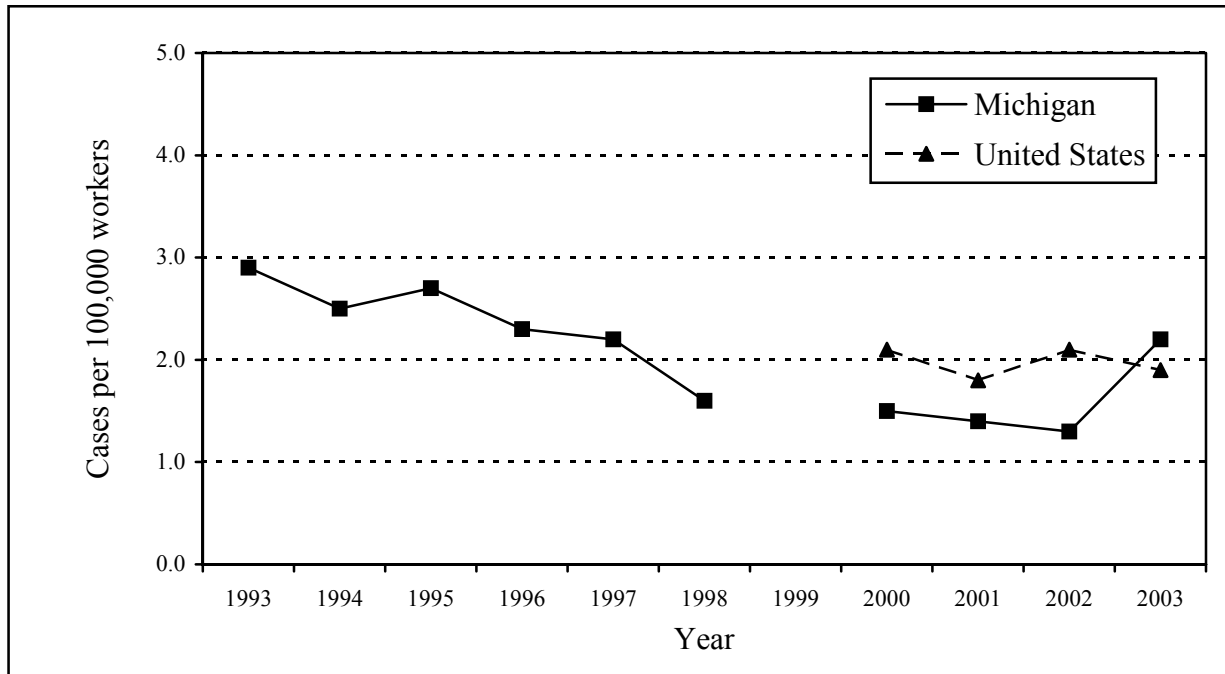
Michigan data for this indicator were derived from reports to the state's two Poison Control Centers. U.S. results were based on data from the Toxic Exposure Surveillance System (TESS), a national database of reports to PCCs throughout the U.S. compiled by the American Association of Poison Control Centers. Figure 11 illustrates the annual work-related pesticide poisoning rates for Michigan during 1993 to 2003 and for the U.S. during 2000-2003 (earlier national data were unavailable as of February 2006). Between 1993 and 2002, Michigan's rates decreased 55%; however, in 2003, the rate increased substantially. During 2000-2003, the national average annual rate exceeded Michigan's average annual rate by 23%. Additional years of data are needed to better compare state and national rates and to elucidate whether 2003 represented the beginning of a trend of increasing rates in Michigan.

Michigan's Occupational Pesticide Illness and Injury Surveillance System

A small number of states have had active programs for occupational pesticide poisoning surveillance that utilized multiple data sources and a rigorous process for confirming cases. Nine of these states, including Michigan, documented 3,098 individuals with acute occupational pesticide-related illness (including three deaths) during 1998-2003 for an incidence rate of 1.1 per 100,000 full-time workers.* The Michigan Department of Community Health joined these states in 2001 by instituting an occupational pesticide poisoning surveillance system through funding from NIOSH. Michigan Poison Control Centers are one of several sources for this system. A report summarizing Michigan data for mid-2001 through 2003 is available.²⁴ Subsequent annual reports on these data are planned.

* Personal communication with Geoffrey Calvert of the National Institute for Occupational Safety and Health (NIOSH).

FIGURE 11
Rate of work-related pesticide-associated poisonings
Michigan and United States, 1993-2003



Data Sources: Numbers of work-related pesticide-associated poisonings: American Association of Poison Control Centers. Employment statistics used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

Technical Notes:

- As of February 2006, national data were not available for 1993-1999. The 1999 data for Michigan had been obtained, but subsequently were revised. The revised data were not provided to MDCH as of February 2006.
- Cases are counted in the Toxic Exposure Surveillance System (TESS) according to the following variable definitions:
 - Exposure to an agent included in one of the pesticide generic categories: fungicides, fumigants, herbicides, insecticides, repellents, disinfectants, or rodenticides; AND
 - Reason=occupational OR Exposure site=workplace; AND
 - Medical outcome is one of the following: minor effect; moderate effect; major effect; death; not followed, minimal clinical effects possible; or, unable to follow, judged as potentially toxic exposure.
- Cases involving exposure to mixtures were excluded.

Indicator 12: Incidence of Malignant Mesothelioma

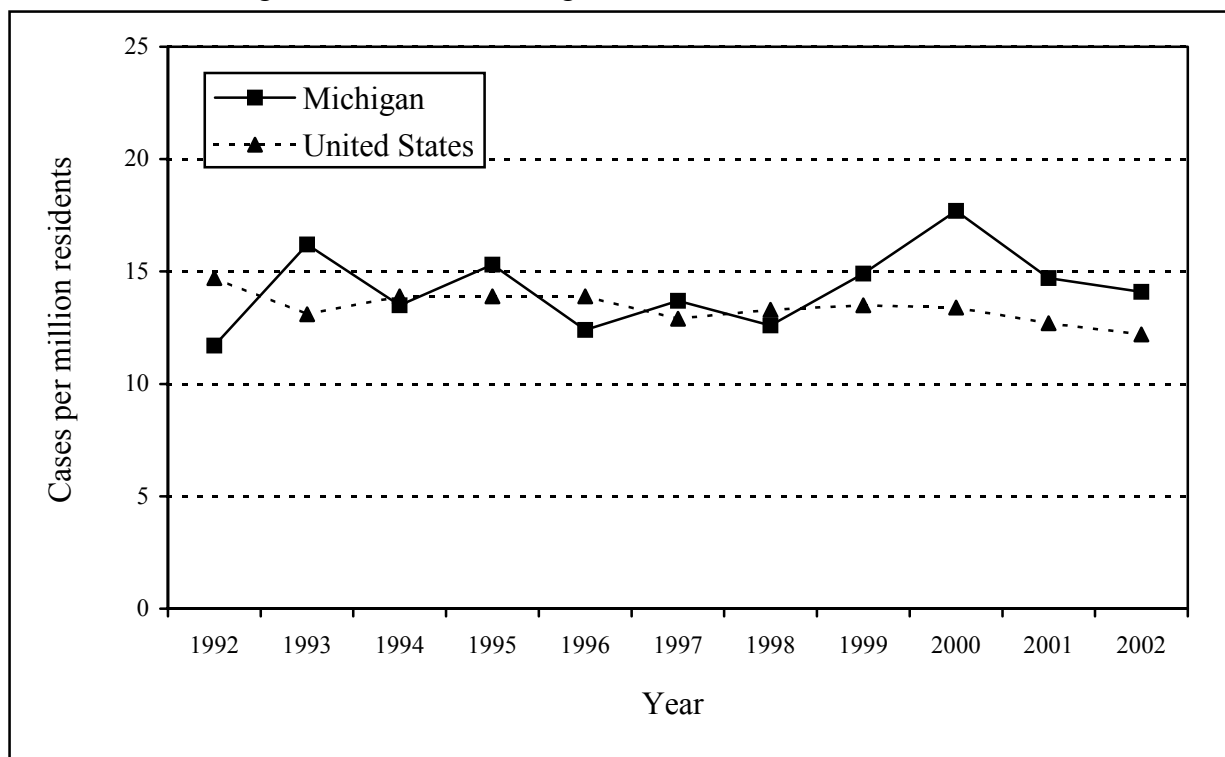
Malignant mesothelioma is a rare but highly fatal cancer of the thin membranes surrounding the chest cavity (pleura) or abdominal cavity (peritoneum). Much less frequently, this tumor affects other anatomical sites (e.g., pericardium). The only well-established risk factor for mesothelioma is exposure to asbestos fibers. Prior asbestos exposure, with the majority of cases occurring after exposure in the workplace, has been reported in 62 to 85 percent of all mesothelioma cases.²⁵

Mesothelioma is a disease of long latency, typically with 20-40 years between exposure and disease onset. The incidence of mesothelioma in the United States has risen steadily since the 1960s, reflecting high levels of asbestos use and occupational exposure to asbestos during World War II through the 1970s. In the 1970s, new Occupational Safety and Health Administration regulations limited workplace exposures and the Environmental Protection Agency began regulating asbestos use. The mesothelioma incidence rate in the U.S. has been projected to begin declining in 2004.²⁶

Approximately 1.3 million workers continue to be exposed to asbestos in many industries and activities.²⁷ Environmental exposure to asbestos is also a continuing concern. Asbestos-containing materials are found in hundreds of thousands of schools and public buildings throughout the country, and asbestos continues to be used in many manufactured products.

The Michigan Cancer Registry collects data on newly diagnosed cancer cases among state residents. The National Cancer Institute estimates national cancer rates using data from cancer registries participating in the Surveillance, Epidemiology, and End Results (SEER) program. Figure 12 illustrates age-standardized incidence rates of malignant mesothelioma among Michigan and U.S. residents aged 15 and older for 1992-2002. Over the eleven-year period, Michigan's rates increased 21%, from 11.7 to 14.1 cases per million residents. National rates declined 17% during this time. Annual numbers and rates of mesothelioma cases are presented in Table 12 in Appendix A.

FIGURE 12
Age-standardized incidence rate of malignant mesothelioma,
ages 15 and older, Michigan and U.S. residents, 1992-2002



Data sources: Number of Michigan mesothelioma cases: Michigan Cancer Registry. Number of residents used to calculate Michigan rates: Population Division, United States Census Bureau. National rates are estimates provided by the National Cancer Institute using the Surveillance, Epidemiology and End Results (SEER) program.

Technical Note:

- A mesothelioma case is coded in the International Classification of Diseases for Oncology (ICD-O)³⁷ histology range 9050-9053.

Indicator 13: Elevated Blood Lead Levels Among Adults

Lead poisoning among adults is primarily due to occupational exposure. Lead adversely affects multiple organ systems and can cause permanent damage. Exposure to lead in adults can cause anemia, nervous system dysfunction, kidney damage, hypertension, decreased fertility, and miscarriage. Workers bringing lead dust home on their clothing or shoes can expose their children to lead.

The blood lead level (BLL) is the best biological indicator of recent lead exposure. The Michigan Occupational Safety and Health Administration requires that employers regularly monitor the BLLs of workers where airborne lead in the workplace exceeds certain levels. The *Healthy People 2010* goal is to eliminate BLLs above 25 micrograms per deciliter ($\mu\text{g}/\text{dL}$) among lead-exposed workers.²⁸ If a worker's average BLL is 50 $\mu\text{g}/\text{dL}$ or greater, the employer is required to remove the worker from exposure. However, adverse health effects have been found at BLLs lower than 40 $\mu\text{g}/\text{dL}$ ²⁹ and 25 $\mu\text{g}/\text{dL}$.³⁰ The average BLL for the general population is less than two $\mu\text{g}/\text{dL}$.³¹

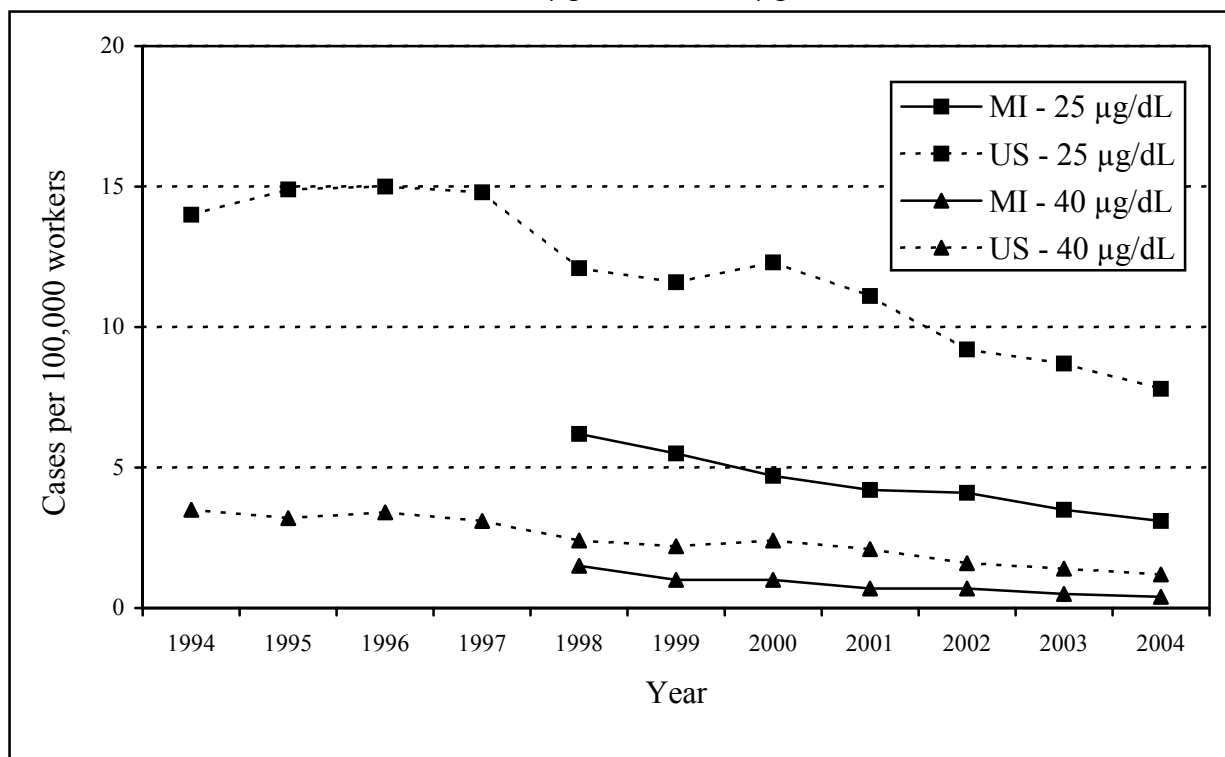
Approximately forty states, including Michigan, participate in compiling data on clinical laboratory reports of BLLs in adults for the national Adult Blood Lead Epidemiology and Surveillance (ABLES) program.³² Reporting by clinical laboratories is mandatory in these states. The regulation for laboratories to report BLLs to the Michigan Department of Community Health went into effect in October, 1997. Occupational exposures account for approximately 80-90% of all reported adults with elevated lead in Michigan.³³⁻³⁵

Figure 13A presents prevalence rates of BLLs $\geq 25 \mu\text{g}/\text{dL}$ and $\geq 40 \mu\text{g}/\text{dL}$ among Michigan (for 1998-2004) and U.S. (for 1994-2004) workers aged 16 and older. Prevalence rates for BLLs $\geq 25 \mu\text{g}/\text{dL}$ and 40 $\mu\text{g}/\text{dL}$ decreased both in the state and nationally. For both measures during the period in common (1998-2004), national rates on average were more than double Michigan rates.

Figure 13B illustrates incidence rates of elevated BLLs for Michigan (1999-2004) and the U.S. (1994-2004). Michigan incidence rates for 1998 are not included as it was not possible to accurately calculate them due to incomplete prevalence data for 1997 (see Technical Notes on page 32 for a description of how incidence is calculated). Incidence rates for BLLs $\geq 25 \mu\text{g}/\text{dL}$ and 40 $\mu\text{g}/\text{dL}$ decreased both in the state and nationally. For both measures during 1999-2004, national rates on average exceeded Michigan rates although to a lesser degree than for prevalence.

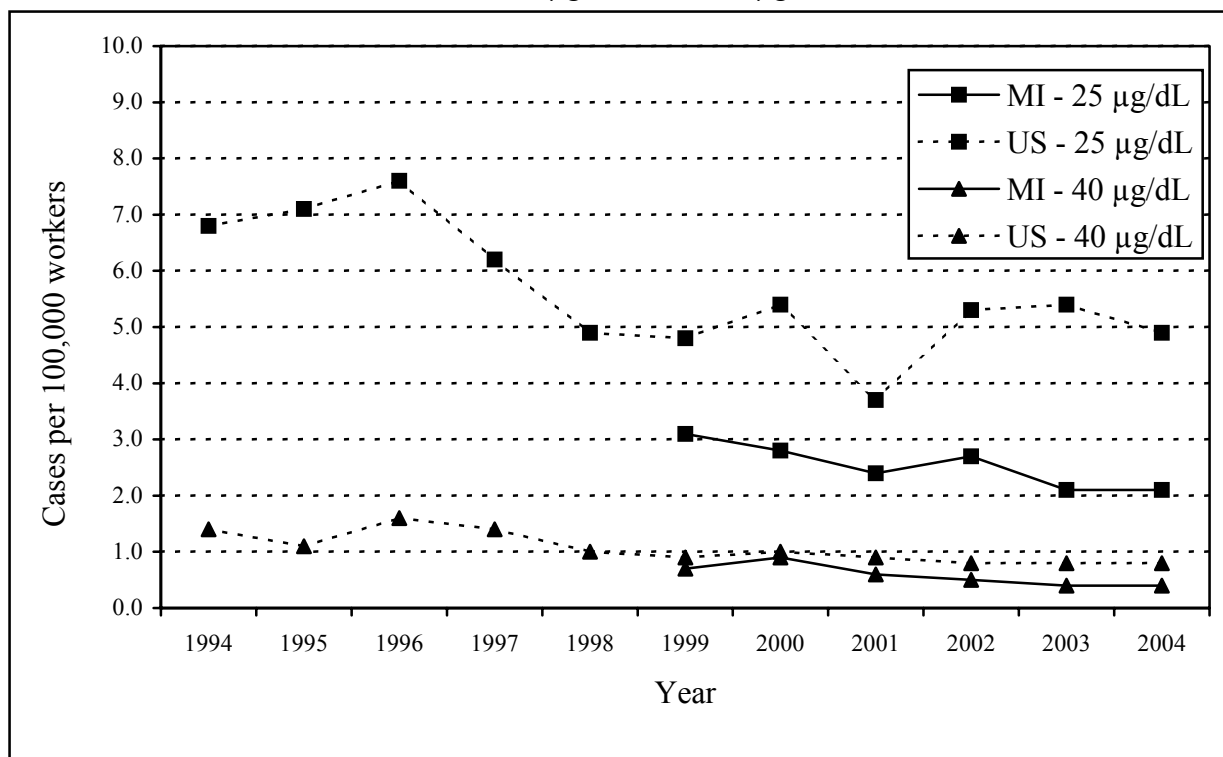
Tables 13.A – 13.D in Appendix A present annual prevalence and incidence data for Michigan and the U.S. for the two BLL measures.

FIGURE 13.A
Prevalence rates of Michigan and U.S. workers aged 16 and older with
blood lead levels $\geq 25 \mu\text{g/dL}$ and $\geq 40 \mu\text{g/dL}$, 1994-2004



Data sources: Number of cases with elevated blood lead levels: Michigan and U.S. Adult Blood Lead Epidemiology Surveillance programs. Employment statistics used to calculate rates: MI: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment; US: BLS Local Area Unemployment Statistics.

FIGURE 13.B
Incidence rates of Michigan and U.S. workers aged 16 and older with
blood lead levels $\geq 25 \mu\text{g/dL}$ and $\geq 40 \mu\text{g/dL}$, 1994-2004



Data sources: Number of cases with elevated blood lead levels: Michigan and U.S. Adult Blood Lead Epidemiology Surveillance programs. Employment statistics used to calculate rates: MI: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment; US: BLS Local Area Unemployment Statistics.

Technical Notes:

- A prevalent case is a person reported at least once in the calendar year with a BLL greater than or equal to 25 $\mu\text{g/dL}$ (or 40 $\mu\text{g/dL}$).
- An incident case is a person with a BLL greater than or equal to 25 $\mu\text{g/dL}$ (or 40 $\mu\text{g/dL}$) who was reported in the calendar year, but not reported in the immediately preceding calendar year with a BLL greater than or equal to 25 $\mu\text{g/dL}$ (or 40 $\mu\text{g/dL}$).
- Rates include all cases of adult elevated BLL reports in the numerators, but the denominators are limited to employed persons. This will result in a slight overestimate of rates per 100,000 employed persons because a small percentage (~10%) of the elevated levels occur in individuals not employed.
- Data published by the ABLES Program may differ from Indicator 13 data because: 1) Indicator 13 includes only resident adults, while ABLES data include all adults reported by each state (residents and nonresidents); 2) lead registries continually correct detected errors, thus published numbers may change over time; 3) Indicator 13 and ABLES use slightly different employment populations to calculate rates.
- U.S. rates are weighted averages based on reports from participating ABLES states. The number of ABLES states increased from 17 in 1994 to 37 in 2004.

APPENDIX A

Data Tables

TABLE 1.A
Number of non-fatal work-related injuries and illnesses reported by private sector employers
by year and type of case, Michigan and United States, 1992-2003

Year	All Cases		Cases with Days Away From Work		Cases with > 10 Days Away From Work	
	MI (000's)	US (000's)	MI (000's)	US (000's)	MI (000's)	US (000's)
1992	299.1	6,799	81.7	2,331	34.0	872.3
1993	310.0	6,737	80.9	2,253	33.5	825.8
1994	337.0	6,767	86.6	2,237	36.5	815.4
1995	332.0	6,575	83.9	2,041	34.0	722.0
1996	327.5	6,239	74.7	1,881	28.9	684.7
1997	298.7	6,146	68.9	1,833	28.1	676.0
1998	280.5	5,923	60.4	1,731	24.2	636.6
1999	269.7	5,707	59.5	1,703	23.8	635.5
2000	262.0	5,650	59.5	1,664	24.4	639.0
2001	226.9	5,216	49.9	1,538	19.9	605.9
2002	202.5	4,701	48.8	1,436	21.8	614.6
2003	185.1	4,365	44.7	1,316	21.6	581.9

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

TABLE 1.B
Rates of non-fatal work-related injuries and illnesses reported by private sector employers
by year and type of case, Michigan and United States, 1992-2003

Year	All Cases		Cases with Days Away From Work	
	MI	US	MI	US
1992	11,100	8,900	3,000	3,000
1993	10,800	8,500	2,800	2,900
1994	11,500	8,400	3,000	2,800
1995	10,900	8,100	2,800	2,500
1996	10,600	7,400	2,400	2,200
1997	9,100	7,100	2,100	2,100
1998	8,600	6,700	1,800	2,000
1999	8,100	6,300	1,800	1,900
2000	8,100	6,100	1,800	1,800
2001	7,300	5,700	1,600	1,700
2002	6,800	5,300	1,600	1,600
2003	6,300	5,000	1,500	1,500

Rates are the number of cases per 100,000 full-time workers. *

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

* The rates published by BLS are the number of injury and illness cases per 100 full-time workers. The rates presented here, which are cases per 100,000 full-time workers, were derived by multiplying BLS published rates by 1,000. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

TABLE 2
Number and rate of work-related hospitalizations
Michigan and United States, 1990-2002

Year	Michigan		United States	
	Number	Rate	Number	Rate
1990	7,496	176.5	399,468	336.3
1991	7,097	170.4	379,215	322.1
1992	6,923	162.0	340,840	287.6
1993	7,444	168.5	387,938	322.6
1994	7,356	162.1	298,367	242.5
1995	6,011	133.8	233,701	187.1
1996	5,875	126.1	223,879	176.7
1997	5,866	122.8	228,031	176.0
1998	5,404	111.8	228,154	173.5
1999	5,338	108.0	211,910	158.7
2000	5,618	112.0	192,109	140.3
2001	5,371	109.6	173,724	126.9
2002	5,114	109.0	193,752	142.0

Rates are the number of hospitalizations per 100,000 workers.
Michigan data reflect Michigan residents hospitalized in-state.
U.S. data are estimates based on a sample.

Data sources: Numbers of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: MI – BLS Geographic Profile of Employment and Unemployment; US – BLS Employment and Earnings.

TABLE 3
Number and rate of fatal work-related injuries
Michigan and United States, 1992-2003

Year	Michigan		United States	
	Number	Rate	Number	Rate
1992	143	3.3	6,217	5.2
1993	160	3.6	6,331	5.3
1994	180	4.0	6,632	5.4
1995	149	3.3	6,275	5.0
1996	155	3.3	6,202	4.9
1997	174	3.6	6,238	4.8
1998	179	3.7	6,055	4.6
1999	182	3.7	6,054	4.5
2000	156	3.1	5,920	4.3
2001	175	3.6	5,915	4.3
2002	152	3.2	5,534	4.1
2003	152	3.3	5,575	4.0

Rates are number of deaths per 100,000 workers aged 16 and older.
For some years U.S. rates listed above differ slightly from those published by BLS due to a minor difference in methodology.

Data sources: Numbers of deaths: Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries. Employment statistics used to calculate rates: MI - BLS Geographic Profile of Employment and Unemployment; US – BLS Employment and Earnings.

TABLE 4
Number and rate of non-fatal amputations resulting in days away from work reported by private sector employers, Michigan and United States, 1992-2003

Year	Michigan		United States	
	Number	Rate	Number	Rate
1992	380	14	12,352	16
1993	549	19	11,342	14
1994	610	21	12,222	15
1995	377	12	11,309	14
1996	563	18	10,167	12
1997	440	14	10,852	13
1998	416	13	10,243	12
1999	479	14	9,985	11
2000	312	10	9,658	11
2001	407	13	8,612	10
2002	253	9	8,793	10
2003	280	10	8,150	9

Rates are the number of cases per 100,000 FTE.

Data source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

Technical note: The rates published by BLS are the number of amputation cases per 10,000 FTEs. The rates presented here, which are amputation cases per 100,000 FTEs, were derived by multiplying BLS published rates by 10. These converted rates are not as precise as those that would be calculated from the raw Annual Survey data.

TABLE 5
Number and rate of lost wage claims for amputations identified in
Michigan's workers' compensation system, 1997-2003

Year	Number	Rate
1997	592	14.3
1998	595	14.0
1999	527	12.1
2000	487	11.0
2001	403	9.3
2002	388	9.1
2003	266	6.4

Rates are the number of cases per 100,000 workers covered by workers' compensation.

Data sources: Number of cases: Michigan workers' compensation system. Number of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

TABLE 6
Number and rate of hospitalizations for work-related burns
Michigan and United States, 1990-2002

Year	Michigan		United States	
	Number	Rate	Number	Rate
1990	159	3.7	11,040	9.3
1991	162	3.9	7,463 ¹	6.3 ¹
1992	106	2.5	5,649 ¹	4.8 ¹
1993	92	2.1	7,538 ¹	6.3 ¹
1994	134	3.0	5,716 ¹	4.6 ¹
1995	115	2.6	6,128 ¹	4.9 ¹
1996	101	2.2	— ²	— ²
1997	108	2.3	— ²	— ²
1998	89	1.8	6,270 ¹	4.8 ¹
1999	105	2.1	5,176 ¹	3.9 ¹
2000	121	2.4	5,370 ¹	3.9 ¹
2001	110	2.2	— ²	— ²
2002	87	1.9	— ²	— ²

1. Per National Center for Health Statistics recommendations, estimates of between 5,000 and 10,000 are to be used with caution.

2. Per National Center for Health Statistics recommendations, estimates of less than 5,000 are not to be used.

Michigan data reflect Michigan residents hospitalized in-state.

U.S. data are estimates as they are based on a sample.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

TABLE 7.A
Work-related Musculoskeletal Disorders Involving Days Away from Work
Reported by Private Industry, Michigan, 1992-2003

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All Musculoskeletal Disorders												
Number	29,938	30,201	32,744	31,119	35,522	23,467	21,711	20,308	21,017	17,378	16,303	15,560
Rate	1,107	1,057	1,118	1,026	1,149	718	663	608	650	562	550	533
Musculoskeletal Disorders of the Neck, Shoulder and Upper Extremities												
Number	8,739	9,295	10,663	10,304	8,348	7,395	6,739	7,608	6,760	6,163	5,360	4,800
Rate	323	325	364	340	270	226	206	228	209	200	180	165
Carpal Tunnel Syndrome												
Number	1,538	2,253	2,126	1,930	1,446	1,491	1,349	1,694	1,261	1,344	1,137	1,260
Rate	57	79	73	64	47	46	41	51	39	43	38	43
Musculoskeletal Disorders of the Back												
Number	16,232	15,276	15,977	15,528	12,935	10,601	10,812	9,669	10,096	7,687	7,667	6,940
Rate	600	535	545	512	418	324	330	290	312	248	259	238

Rates are the number of cases per 100,000 full-time workers.

Data Source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

TABLE 7.B
Work-related Musculoskeletal Disorders Involving Days Away from Work
Reported by Private Industry, United States, 1992-2003

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All Musculoskeletal Disorders												
Number	784,145	762,727	755,594	695,789	647,355	626,352	592,544	557,265	577,814	522,528	487,915	435,180
Rate	1,025	967	936	853	770	725	668	616	629	575	553	496
Musculoskeletal Disorders of the Neck, Shoulder and Upper Extremities												
Number	188,053	195,117	193,563	179,819	165,451	163,499	154,874	156,734	160,156	147,580	135,236	125,050
Rate	246	247	240	221	196	189	175	173	174	163	154	142
Carpal Tunnel Syndrome												
Number	32,609	40,679	38,100	31,313	29,820	28,865	26,185	27,832	27,571	26,522	22,583	22,110
Rate	43	52	47	38	36	33	30	31	30	29	26	25
Musculoskeletal Disorders of the Back												
Number	450,305	428,822	418,969	381,953	348,000	334,261	315,133	302,744	293,033	265,018	246,103	212,380
Rate	589	544	519	468	414	387	355	335	319	292	279	247

Rates are the number of cases per 100,000 full-time workers.

Data Source: Bureau of Labor Statistics Annual Survey of Occupational Injuries and Illnesses

TABLE 8
Number and rate of lost work time claims for carpal tunnel syndrome cases identified in
Michigan's workers' compensation system, 1997-2003

Year	Number	Rate
1997	1,168	28.2
1998	870	20.5
1999	1,011	23.3
2000	1,040	23.5
2001	953	22.0
2002	1,125	26.5
2003	1,116	26.7

Rates are the number of cases per 100,000 workers covered by workers' compensation.

Data sources: Number of CTS cases: Michigan workers' compensation system. Number of workers covered by workers' compensation used to calculate rates: National Academy of Social Insurance.

TABLE 9.A
Number and rate of hospitalizations for all pneumoconioses,
ages 15 and older, Michigan and United States, 1990-2002

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	516	71.2	76.3	15,567	79.7	83.6
1991	531	72.7	77.5	22,307	113.2	120.3
1992	578	78.4	82.7	26,084	131.0	136.0
1993	533	71.9	75.6	19,843	98.7	103.4
1994	513	68.7	71.8	25,248	124.4	127.4
1995	580	76.9	80.0	30,061	146.6	152.3
1996	661	86.8	90.2	28,527	137.4	140.5
1997	675	88.1	91.0	33,073	157.7	161.7
1998	689	89.6	92.1	24,570	115.8	116.4
1999	744	96.2	98.4	25,294	118.1	118.8
2000	752	96.5	98.4	31,755	143.8	146.1
2001	830	105.5	107.4	25,710	114.9	116.2
2002	849	107.2	108.0	32,795	144.7	145.8

Rates are the number of hospitalizations per million residents.

Michigan data reflect Michigan residents hospitalized in-state.

A case is defined as a hospital discharge with a principal or secondary diagnosis in the ICD-9-CM range 500-505.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: United States Census Bureau.

TABLE 9.B
Number and rate of hospitalizations for coal workers' pneumoconiosis
ages 15 and older, Michigan and United States, 1990-2002

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	219	30.2	33.2	7,377 ¹	37.8 ¹	39.1 ¹
1991	233	31.9	34.0	10,825	54.9	60.2
1992	210	28.5	30.4	10,270	51.6	53.3
1993	192	25.9	27.5	8,422 ¹	41.9 ¹	43.6 ¹
1994	164	22.0	23.0	8,936 ¹	44.0 ¹	44.7 ¹
1995	184	24.4	25.5	15,704	76.6	80.5
1996	198	26.0	27.2	11,452	55.2	56.8
1997	190	24.8	25.8	15,319	73.1	75.2
1998	181	23.5	24.4	7,790 ¹	36.7 ¹	36.7 ¹
1999	163	21.1	21.7	7,694 ¹	35.9 ¹	36.3 ¹
2000	153	19.6	20.1	9,715 ¹	44.0 ¹	44.7 ¹
2001	157	20.0	20.2	6,236 ¹	27.9 ¹	28.0 ¹
2002	144	18.2	18.1	8,657 ¹	38.2 ¹	38.0 ¹

1. Per National Center for Health Statistics recommendations, estimates of between 5,000 and 10,000 are to be used with caution.

Rates are the number of hospitalizations per million residents.

Michigan data reflect Michigan residents hospitalized in-state.

A case is defined as a hospital discharge with a principal or secondary diagnosis with the ICD-9-CM code 500.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: United States Census Bureau.

TABLE 9.C
Number and rate of hospitalizations for asbestosis
ages 15 and older, Michigan and United States, 1990-2002

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	144	19.9	20.8	— ¹	— ¹	— ¹
1991	157	21.5	22.3	6,578 ²	33.4 ²	34.8 ²
1992	206	27.9	28.7	11,138	56.0	58.8
1993	201	27.1	27.9	8,179 ²	40.7 ²	42.8 ²
1994	227	30.4	31.5	10,077	49.6	51.1
1995	258	34.2	35.0	9,264 ²	45.2 ²	45.8 ²
1996	312	41.0	42.2	12,680	61.1	61.7
1997	328	42.8	43.7	13,740	65.5	67.1
1998	376	48.9	50.1	14,500	68.3	68.9
1999	440	56.9	58.0	14,293	66.7	66.9
2000	479	61.4	62.6	20,223	91.6	93.0
2001	575	73.1	74.6	18,523	82.8	84.0
2002	575	72.6	73.6	22,441	99.0	100.2

1. Per National Center for Health Statistics recommendations, estimates of less than 5,000 are not to be used.

2. Per National Center for Health Statistics recommendations, estimates of between 5,000 and 10,000 are to be used with caution.

Rates are the number of hospitalizations per million residents.

Michigan data reflect Michigan residents hospitalized in-state.

A case is defined as a hospital discharge with a principal or secondary diagnosis with the ICD-9-CM code 501.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: United States Census Bureau

TABLE 9.D
Number and rate of hospitalizations for silicosis
ages 15 and older, Michigan and United States, 1990-2002

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	101	13.9	14.8	— ¹	— ¹	— ¹
1991	106	14.5	16.0	— ¹	— ¹	— ¹
1992	124	16.8	18.1	— ¹	— ¹	— ¹
1993	94	12.7	13.4	— ¹	— ¹	— ¹
1994	86	11.5	12.2	— ¹	— ¹	— ¹
1995	104	13.8	14.6	— ¹	— ¹	— ¹
1996	119	15.6	16.4	— ¹	— ¹	— ¹
1997	107	14.0	14.7	— ¹	— ¹	— ¹
1998	108	14.0	14.5	— ¹	— ¹	— ¹
1999	108	14.0	14.3	— ¹	— ¹	— ¹
2000	106	13.6	13.9	— ¹	— ¹	— ¹
2001	74	9.4	9.6	— ¹	— ¹	— ¹
2002	105	13.3	13.2	— ¹	— ¹	— ¹

1. Per National Center for Health Statistics recommendations, estimates of less than 5,000 are not to be used. Rates are the number of hospitalizations per million residents. Michigan data reflect Michigan residents hospitalized in-state. A case is defined as a hospital discharge with a principal or secondary diagnosis with the ICD-9-CM code 502.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey. Population statistics used to calculate rates: United States Census Bureau.

TABLE 9.E
Number and rate of hospitalizations for other and unspecified pneumoconioses
ages 15 and older, Michigan and United States, 1990-2002

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	55	7.6	7.9	— ¹	— ¹	— ¹
1991	37	5.1	5.4	— ¹	— ¹	— ¹
1992	41	5.6	6.1	— ¹	— ¹	— ¹
1993	51	6.9	7.5	— ¹	— ¹	— ¹
1994	36	4.8	5.0	— ¹	— ¹	— ¹
1995	41	5.4	5.8	— ¹	— ¹	— ¹
1996	37	4.9	5.0	— ¹	— ¹	— ¹
1997	53	6.9	7.2	— ¹	— ¹	— ¹
1998	29	3.8	3.8	— ¹	— ¹	— ¹
1999	39	5.0	5.1	— ¹	— ¹	— ¹
2000	17	2.2	2.2	— ¹	— ¹	— ¹
2001	32	4.1	4.1	— ¹	— ¹	— ¹
2002	31	3.9	3.9	— ¹	— ¹	— ¹

1. Per National Center for Health Statistics recommendations, estimates of less than 5,000 are not to be used.
Rates are the number of hospitalizations per million residents.
Michigan data reflect Michigan residents hospitalized in-state.
A case is defined as a hospital discharge with a principal or secondary diagnosis in the ICD-9-CM range 503-505.

Data sources: Number of hospitalizations: Michigan Inpatient Database and National Hospital Discharge Survey.
Population statistics used to calculate rates: United States Census Bureau.

TABLE 10.A
Deaths from or with pneumoconiosis
Michigan residents aged 15 and older, 1990-2003

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change to ICD10 coding	1999	2000	2001	2002	2003
Total pneumoconiosis ¹															
Number of deaths	57	41	47	48	39	45	51	38	37		47	40	45	47	45
Death rate	7.9	5.6	6.4	6.5	5.2	6.0	6.7	5.0	4.8		6.1	5.1	5.7	5.9	5.6
Age-standardized death rate	8.6	6.1	6.6	6.9	5.6	6.3	7.2	5.0	5.0		6.3	5.3	5.9	6.0	5.7
Coal workers' pneumoconiosis															
Number of deaths	21	15	10	10	11	6	10	8	7		6	8	7	8	4
Death rate	2.9	2.1	1.4	1.3	1.5	0.8	1.3	1.0	0.9		0.8	1.0	0.9	1.0	*
Age-standardized death rate	3.4	2.3	1.5	1.4	1.6	0.8	1.4	1.1	1.0		0.8	1.1	0.9	1.0	*
Asbestosis															
Number of deaths	14	15	16	16	17	23	20	23	16		30	24	32	29	35
Death rate	1.9	2.1	2.2	2.2	2.3	3.1	2.6	3.0	2.1		3.9	3.1	4.1	3.7	4.4
Age-standardized death rate	2.0	2.1	2.2	2.2	2.4	3.2	2.8	3.0	2.1		4.0	3.2	4.2	3.7	4.5
Silicosis															
Number of deaths	12	7	14	15	7	12	16	4	9		5	8	4	4	4
Death rate	1.7	1.0	1.9	2.0	0.9	1.6	2.1	*	1.2		*	1.0	*	*	*
Age-standardized death rate	1.7	1.1	2.0	2.2	1.0	1.7	2.3	*	1.2		*	1.1	*	*	*
Other and unspecified pneumoconiosis															
Number of deaths	10	4	7	7	4	4	5	3	5		6	0	2	6	2
Death rate	1.4	*	0.9	0.9	*	*	*	*	*		0.8	-	*	0.8	*
Age-standardized death rate	1.5	*	0.9	1.0	*	*	*	*	*	0.8	-	*	0.7	*	

Rates are the number of deaths per million residents.

1. Total may not be equivalent to the sum of the subcategories as deaths can involve more than one form of pneumoconiosis.

* Reliable rate could not be calculated.

ICD9 code range for 1990-1998 deaths: 500-505

ICD10 code range for 1999-2003 deaths: J60-J66

For pneumoconiosis, the comparability ratio²⁰ is estimated at 1.0178 meaning that the change in coding systems from ICD9 to ICD10 by itself inflates counts of post-1998 pneumoconiosis deaths by 1.0178, or 1.78%. The comparability ratios of the individual components within pneumoconiosis are unknown.

Data sources: Number of deaths: Vital Records and Health Data Development Section, Michigan Department of Community Health. Population statistics used to calculate rates: United States Census Bureau.

TABLE 10.B
Deaths from or with pneumoconiosis
United States residents aged 15 and older, 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change to ICD10 coding	1999	2000	2001	2002
Total pneumoconiosis ¹														
Number of deaths	3,644	3,486	3,230	3,238	3,127	3,151	3,115	2,928	2,791		2,745	2,864	2,747	2,718
Death rate	18.7	17.7	16.2	16.1	15.4	15.4	15.0	14.0	13.2		12.8	13.0	12.3	12.0
Age-standardized death rate	19.8	18.6	17.0	16.7	15.9	15.8	15.3	14.2	13.3		12.9	13.2	12.4	12.1
Coal workers' pneumoconiosis														
Number of deaths	1,990	1,938	1,766	1,631	1,478	1,413	1,417	1,297	1,103		1,003	950	889	858
Death rate	10.2	9.8	8.9	8.1	7.3	6.9	6.8	6.2	5.2		4.7	4.3	4.0	3.8
Age-standardized death rate	10.9	10.5	9.4	8.5	7.6	7.1	7.0	6.3	5.3		4.7	4.4	4.0	3.8
Asbestosis														
Number of deaths	948	946	959	999	1,060	1,169	1,176	1,171	1,221		1,265	1,493	1,454	1,473
Death rate	4.9	4.8	4.8	5.0	5.2	5.7	5.7	5.6	5.8		5.9	6.8	6.5	6.5
Age-standardized death rate	5.0	4.9	4.9	5.1	5.3	5.8	5.7	5.7	5.8		5.9	6.9	6.6	6.6
Silicosis														
Number of deaths	308	314	255	276	236	242	213	198	178		187	152	164	148
Death rate	1.6	1.6	1.3	1.4	1.2	1.2	1.0	0.9	0.8		0.9	0.7	0.7	0.6
Age-standardized death rate	1.7	1.7	1.3	1.4	1.2	1.2	1.1	1.0	0.9		0.9	0.7	0.7	0.7
Other and unspecified pneumoconiosis														
Number of deaths	428	333	288	375	401	367	358	297	335		325	307	277	264
Death rate	2.2	1.7	1.5	1.9	2.0	1.8	1.7	1.4	1.6		1.5	1.4	1.2	1.1
Age-standardized death rate	2.3	1.8	1.5	1.9	2.1	1.9	1.8	1.5	1.6	1.5	1.4	1.3	1.1	

Rates are the number of deaths per million residents.

1. Total may not be equivalent to the sum of the subcategories as deaths can involve more than one form of pneumoconiosis.

ICD9 code range for 1990-1998 deaths: 500-505

ICD10 code range for 1999-2003 deaths: J60-J66

For pneumoconiosis, the comparability ratio²⁰ is estimated at 1.0178 meaning that the change in coding systems from ICD9 to ICD10 by itself inflates counts of post-1998 pneumoconiosis deaths by 1.0178, or 1.78%. The comparability ratios of the individual components within pneumoconiosis are unknown.

Data source: National Surveillance System for Pneumoconiosis Mortality, National Institute for Occupational Safety and Health

TABLE 11
Number and rate of work-related pesticide-associated poisoning
reported to poison control centers, Michigan and U.S., 1993-2003

Year	Michigan		United States	
	Number	Rate	Number	Rate
1993	128	2.9	NA	NA
1994	115	2.5	NA	NA
1995	122	2.7	NA	NA
1996	108	2.3	NA	NA
1997	103	2.2	NA	NA
1998	79	1.6	NA	NA
1999	NA	NA	NA	NA
2000	74	1.5	2,827	2.1
2001	71	1.4	2,474	1.8
2002	59	1.3	2,832	2.1
2003	104	2.2	2,659	1.9

Rates are the number of cases per 100,000 workers.

NA – not available as of February 2006. The 1999 data for Michigan had been obtained, but subsequently were revised. The revised data were not provided to MDCH as of February 2006.

Data sources: Number of cases: American Association of Poison Control Centers. Employment statistics used to calculate rates: Geographic Profile of Employment and Unemployment.

Technical notes: Prior to 2003, not every state participated in the AAPCC Toxic Exposure Surveillance System (TESS). States not participating were as follows:

2000: AK, HI, ND, SC, VT, portion of MS

2001: ND, MS

2002: ND

TABLE 12
Incidence of malignant mesothelioma,
ages 15 and older, Michigan and U.S. residents, 1990-2002

Year	Michigan			United States		
	Number	Crude Rate	Age-Adjusted Rate	Number	Crude Rate	Age-Adjusted Rate
1990	81	11.2	12.2	NA	NA	NA
1991	69	9.4	9.9	NA	NA	NA
1992	82	11.1	11.7	NA	NA	14.7
1993	115	15.5	16.2	NA	NA	13.1
1994	95	12.7	13.5	NA	NA	13.9
1995	112	14.9	15.3	NA	NA	13.9
1996	93	12.2	12.4	NA	NA	13.9
1997	103	13.4	13.7	NA	NA	12.9
1998	95	12.3	12.6	NA	NA	13.3
1999	113	14.6	14.9	NA	NA	13.5
2000	136	17.4	17.7	NA	NA	13.4
2001	114	14.5	14.7	NA	NA	12.7
2002	111	14.0	14.1	NA	NA	12.2

Rates are the number of cases per million residents.
NA – Data not available as of February 2006.

Data sources: Number of Michigan cases: Michigan Cancer Registry. Population statistics used to calculate Michigan rates: United States Census Bureau. United States numbers and rates: National Cancer Institute.

TABLE 13.A
Prevalence of elevated blood lead levels
Michigan residents aged 16 and older, 1998-2004

Measure (µg/dL)	1998	1999	2000	2001	2002	2003	2004
≥ 25 – number	298	272	238	207	194	163	149
≥ 25 – rate	6.2	5.5	4.7	4.2	4.1	3.5	3.1
≥ 40 – number	72	47	48	36	31	24	21
≥ 40 – rate	1.5	1.0	1.0	0.7	0.7	0.5	0.4

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: Michigan Adult Blood Lead Epidemiology Surveillance (ABLES) program. Employment estimates used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

TABLE 13.B
Incidence of elevated blood lead levels
Michigan residents aged 16 and older, 1998-2004

Measure (µg/dL)	1998	1999	2000	2001	2002	2003	2004
≥ 25 – number	--- ¹	152	140	118	125	98	101
≥ 25 – rate	--- ¹	3.1	2.8	2.4	2.7	2.1	2.1
≥ 40 – number	--- ¹	33	44	29	25	21	20
≥ 40 – rate	--- ¹	0.7	0.9	0.6	0.5	0.4	0.4

1. Incidence cannot be calculated for 1998. The regulation for laboratories to report BLLs to MDCH took effect in October, 1997, thus the prevalence for 1997 is incomplete. The calculation of incidence is based on prevalence for the prior year.

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: Michigan Adult Blood Lead Epidemiology Surveillance (ABLES) program. Employment estimates used to calculate rates: Bureau of Labor Statistics Geographic Profile of Employment and Unemployment.

TABLE 13.C
Prevalence of elevated blood lead levels
U.S. residents aged 16 and older, 1994-2002
(number of states reporting in parentheses)

Measure (µg/dL)	1994 (17)	1995 (18)	1996 (20)	1997 (24)	1998 (24)	1999 (25)	2000 (25)	2001 (23)	2002 (35)	2003 (37)	2004 (37)
≥ 25 – number	9,225	10,260	11,607	12,614	10,459	10,310	11,077	9,730	10,676	10,413	9,546
≥ 25 – rate	14.0	14.9	15.0	14.8	12.1	11.6	12.3	11.1	9.2	8.7	7.8
≥ 40 – number	2,119 ¹	2,024 ²	2,643	2,668	2,071	1,933	2,125	1,835	1,860	1,734	1,504
≥ 40 – rate	3.5	3.2	3.4	3.1	2.4	2.2	2.4	2.1	1.6	1.4	1.2

1. Sixteen (16) states reported prevalence of 40 µg/dL in 1994.

2. Seventeen (17) states reported prevalence of 40 µg/dL in 1995.

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: national Adult Blood Lead Epidemiology Surveillance (ABLES) program.

Employment estimates used to calculate rates: Bureau of Labor Statistics' Current Population Survey.

TABLE 13.D
Incidence of elevated blood lead levels
U.S. residents aged 16 and older, 1994-2002
(number of states reporting in parentheses)

Measure (µg/dL)	1994 (16)	1995 (16)	1996 (19)	1997 (24)	1998 (24)	1999 (25)	2000 (24)	2001 (20)	2002 (35)	2003 (37)	2004 (37)
≥ 25 – number	4,356	4,579	5,716	5,313	4,284	4,237	4,852	2,867	6,196	6,501	5,935
≥ 25 – rate	6.8	7.1	7.6	6.2	4.9	4.8	5.4	3.7	5.3	5.4	4.9
≥ 40 – number	799 ³	657 ³	1,235	1,212	907	791	930	674	913	953	915
≥ 40 – rate	1.4	1.1	1.6	1.4	1.0	0.9	1.0	0.9	0.8	0.8	0.8

3. Fifteen (15) states reported incidence of 40 µg/dL in 1994 and 1995.

Rates are the number of cases per 100,000 workers.

Data sources: Number of cases with elevated blood lead levels: national Adult Blood Lead Epidemiology Surveillance (ABLES) program.

Employment estimates used to calculate rates: Bureau of Labor Statistics' Current Population Survey.

Technical Note: Counts represent residents and non-residents of reporting states. The denominators for calculating rates include only the resident workers of reporting states.

APPENDIX B

Description of Data Sources

The following sources were used to generate the thirteen occupational health indicators and the employment demographics for Michigan and the U.S. The first nine listed sources provided data for counts and the numerators for rate calculations. The last six were used to quantify the appropriate population at risk (i.e., denominators) for the calculation of rates and provided data for employment demographics.

Death Certificates

In Michigan, funeral directors, attending physicians, and medical examiners are responsible for the personal and medical information recorded on death certificates. Local registrars assure that all deaths in their jurisdictions are registered and that required information is documented before sending certificates to the Division for Vital Records and Health Statistics at the Michigan Department of Community Health (MDCH). State registrars number and file the death certificates and forward certificates of nonresidents to the appropriate state. All states send death certificate data to the National Vital Statistics System, managed by the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics.

The cause-of-death section on the certificate, which is similar in all states, contains the immediate, contributing and underlying causes of death. Since 1999, these causes have been coded according to the International Classification of Diseases, tenth revision (ICD-10)³⁶ format. For injury deaths, death certificates include a query about whether the incident occurred at work.

Michigan Cancer Registry

Data on cancer incidence and mortality are maintained in a registry at the Vital Records and Health Data Development Section of MDCH. Sources of incidence data include hospitals, laboratories, health clinics, dentists, physicians, nursing homes, and hospice. The registry is routinely linked to death certificate data to maintain the vital status of patients and augment the registry with demographic and other information from the death certificate. The registry was formed in 1985 under the authority of Act 82 of 1984 which established cancer as a reportable disease. Standards for the operation of cancer registries (e.g., data definitions, data transmission methodologies, and quality assurance) have been developed by the North American Association of Central Cancer Registries (NAACCR). Diagnoses are coded according to the International Classification of Diseases for Oncology (ICD-O).³⁷

Surveillance, Epidemiology and End Results (SEER)

National mesothelioma incidence estimates in this report were provided by the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute (NCI). SEER began collecting data on cancer cases in 1973 from five states and two metropolitan areas. As of 2005, the Program was collecting cancer incidence and survival data from 14 population-based cancer registries and three supplemental registries covering 26% of the U.S. population. Approximately 170,000 new cases are added each year from SEER coverage areas. Data routinely collected include patient demographics, primary tumor site, morphology, stage at diagnosis, first course of treatment and follow-up for vital status. Quality control is an integral part of the SEER program. Every year, studies are conducted to evaluate the quality and completeness of reported data. NCI generates data on cancer incidence at the county, state and national levels using statistical modeling of county-level demographic and lifestyle characteristics and data from SEER. This is an improvement over previous incidence estimates which were based on the assumption that every state's incidence/mortality ratio was equivalent.³⁸

Hospital Discharge Data

Patient demographics, diagnoses, and billing information are contained within hospital medical records. Upon patient discharge from a hospital, these data are computerized using standard formats. Diagnoses are coded according to the International Classification of Diseases system, currently ICD-9-CM.³⁹ In Michigan, every acute care hospital voluntarily submits data to the Michigan Health and Hospital Association. This aggregated dataset is the Michigan Inpatient Database (MIDB).

National hospitalization data were obtained through the National Center for Health Statistics National Hospital Discharge Survey (NHDS). The NHDS annually collects data from a sample of approximately 270,000 inpatient records from 500 short-stay, non-federal hospitals. The NHDS uses a three-stage probability design. The first stage of sampling consists of primary sampling units (PSUs) comprised generally of counties or groups of counties. In the second stage of sampling, a systematic random sample of hospitals from within sample PSUs are selected. In the third stage, a sample of inpatient records are selected within sample hospitals.

Hospital discharge data have several limitations for providing information on occupational health. There is no specific query as to the work-relatedness of any illness or injury. A useful proxy for work-related injury is workers' compensation insurance as the payer. Workers' compensation as the payer source is much less sensitive in identifying illnesses. Illnesses are much harder to associate with a work condition due to the non-specificity of many occupational diseases or the long latency between exposure and onset of overt disease. Personal identifiers are not available, thus repeat hospitalizations of the same individual cannot be identified. Federal hospitals (military and veterans' hospitals) are not included in the MIDB or the NHDS.

Workers' Compensation

Workers' compensation is a no-fault insurance system designed to provide compensation to workers who sustain work-related injuries or illnesses while limiting the legal liability of employers. In Michigan, nearly all private and non-federal public employers are required to have workers' compensation coverage for their employees per the Workers' Disability Compensation Act of 1969. Employers are allowed to self-insure, group self-insure, insure through private carriers, or insure through a state fund. In general, a worker who sustains a work-related injury or illness reports this to the employer who then sends the worker to a healthcare professional and reports the incident to the company's insurance carrier. If an incident results in death, certain injuries (e.g., amputation), or the employee missing more than seven consecutive days of work, the employer submits a Form 100 to the Bureau of Workers' and Unemployment Compensation (BWUC) at the Michigan Department of Labor and Economic Growth. Data on Form 100s, which contain information on employee demographics and the injury/illness, are entered into an administrative database.

Although all states have workers' compensation systems, there are significant state-to-state differences in coverage, procedures for filing claims, and data that are collected. There are no national injury/illness data from workers' compensation claims.

Survey of Occupational Injuries and Illnesses

The Survey of Occupational Injuries and Illnesses (Annual Survey), conducted by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor, provides annual estimates of the numbers and incidence rates of work-related injuries and illnesses among private sector workers nationwide. Information is collected through an annual survey mailed to a stratified random sample of establishments (in Michigan, the survey is conducted by the Michigan Occupational Safety and Health Administration [MIOSHA] within the Michigan Department of Labor and Economic Growth). Employers respond to the survey using information on work-related injuries and illnesses that is recorded as required under the Occupational Safety and Health Administration (OSHA) record-keeping standard 29 CFR 1904. Recordable injuries and illnesses include those that result in loss of consciousness, one or more days away from work to recuperate, restricted work activity, transfer to another job, or medical treatment beyond simple first aid. More detailed information on worker demographics and the nature and circumstances of the injuries and illnesses is collected for cases resulting in days away from work. The Annual Survey also collects data on the average number of workers employed and the total hours worked at each establishment, information that allows the BLS to calculate rates. Since 1996, the Survey sample has included approximately 180,000 private sector establishments nationwide.

Most states, including Michigan, participate in the federal-state survey program, which involves allocation of state resources. For these states, an independent sample is selected and the survey data generate state as well as national estimates. In states where the public sector is covered by a state OSHA plan (e.g., Michigan), the Annual Survey includes public sector workers. Because the Annual Survey is based on a sample – and not a census – of all establishments, its findings are estimates with corresponding sampling errors. The BLS adheres to strict publication guidelines based on the reliability of the estimates; numbers and rates are not published or released by the BLS if the estimates do not meet these guidelines.

The self-employed, farms with fewer than 11 employees, private households, federal agencies, and the military are not covered in the Annual Survey. It is well recognized that the survey undercounts work-related illnesses, especially long-latency illnesses that may not appear until years after individuals have left their place of employment. There is also some evidence that work-related injuries are underreported.^{5,6}

Census of Fatal Occupational Injuries

The Census of Fatal Occupational Injuries (CFOI), conducted by the Bureau of Labor Statistics (BLS) in the U.S. Department of Labor, is a federal-state cooperative program that compiles an annual census of fatal occupational injuries at both the state and national levels. In Michigan, data are collected by the Michigan Occupational Safety and Health Administration (MIOSHA) within the Michigan Department of Labor and Economic Growth. For a death to be counted, the decedent must have been working for pay, compensation or profit at the time of the event, engaged in a legal work activity, or present at the site of the incident as a requirement of his or her job. The census includes unintentional injuries (e.g., falls, electrocutions, motor vehicle crashes) and intentional injuries (homicide and suicide). Deaths due to occupational illnesses are excluded. CFOI uses multiple data sources to identify and document work-related injury deaths. These sources include, among others, death certificates, workers' compensation records, reports to regulatory agencies, medical examiner and police reports, as well as reports in the news media. Multiple sources are used because studies have found that no single source captures all deaths. In addition, two or more sources are required to ensure an accurate count by

independently substantiating that incidents were work-related. Due to this methodology, CFOI counts are considered a complete or near complete ascertainment of work-related injury deaths.

Poison Control Centers

Poison control centers (PCCs) are available nationwide to provide assistance 24 hours a day to callers with concerns about actual or potential exposure to substances. Calls originating from Michigan are handled by either Children's Hospital of Michigan in Detroit or DeVos Children's Hospital in Grand Rapids. Most PCCs, including the two in Michigan, track calls and manage case information electronically using ToxiCall®. Centers submit data on a realtime basis to the American Association of Poison Control Centers (AAPCC) for inclusion in their Toxic Exposure Surveillance System (TESS). In 2002, 64 PCCs representing 99.8% of the nation's population submitted data to the AAPCC.⁴⁰

PCCs categorize inquiries as human or animal exposures, or non-exposures and information-only. For nearly half of human exposure calls, PCCs follow up to provide further guidance, confirm compliance with recommendations, and gather outcome data.⁴⁰ The types of information gathered by PCCs include demographics, type of substance(s) involved, symptoms, intentionality of exposure, whether the exposure was work-related, location of exposure (e.g., workplace), and medical outcome. PCCs do not systematically collect information on industry and occupation. Centers that use ToxiCall® can generate nearly 100 standard reports or create ad hoc reports to meet more specific needs. A significant limitation of PCC data for occupational surveillance is that it is a passive system; that is, it relies on cases to be reported. To report a case, the poisoned individual or a health care worker has to know about the existence of a PCC, consider it a source of assistance for addressing a work-related illness, and know how to contact the PCC. Because of the passive surveillance system design, it is likely that PCC data underestimate the true extent of work-related chemical exposures.

Adult Blood Lead Epidemiology and Surveillance

The Adult Blood Lead Epidemiology and Surveillance (ABLES) system, a state-based program funded by CDC's National Institute for Occupational Safety and Health (NIOSH), commenced in 1987 in four states. As of 2005, 38 states, including Michigan, were participating in the system. Surveillance of elevated blood lead levels (BLLs) provides a method for identifying industries and occupations where workers are at high risk for exposure to lead. States participating in ABLES require that clinical laboratories report BLL results to a state agency. In Michigan, results are sent to MDCH which subsequently forwards reports for adults to the Michigan State University College of Human Medicine, Occupational and Environment Medicine Division. Laboratory reports include basic demographic information. States use unique identifiers to differentiate between new and existing cases and to account for multiple reports for the same person. Most states follow up reports of elevated BLLs to determine the sources of lead exposure, including the name of the employer, and additional information about the exposed individual. The Occupational Safety and Health Administration (OSHA) requires that lead be measured clinically in workers exposed to airborne lead exceeding a certain level. Because of this requirement and because laboratories generally comply with the reporting requirement, ABLES programs are believed to identify a substantial portion of lead-exposed workers. However, they do not capture lead-exposed individuals whose employers are not in compliance with the biological monitoring requirements, or individuals tested by laboratories that are not compliant with the reporting requirement. Data from ABLES states are submitted to NIOSH, where they are aggregated. Analyses based on the aggregate data are published in CDC's Morbidity and Mortality Weekly Report (MMWR). The aggregated data from ABLES are not

necessarily representative of the nation as there is less than 100% participation; states that participate were not selected based on representativeness.

Census

The U.S. Census Bureau takes the census of the entire nation in years ending in zero. Census data are used to distribute government funding, draw state legislative districts, identify populations in need of services, determine business locations, and for many other purposes. In Census 2000, a short form was sent to every household, and a long form with more detailed questions was sent to a sample of about one in six households. The short form ascertained basic demographics, while the long form sought information on social, economic, and financial characteristics of individuals, and physical characteristics of housing. The economic characteristics included labor force status, place of work, occupation, industry, work status, and income. Following Census 2000, there was debate about undercounting the population. Subsequently, the Census Bureau performed a coverage measurement survey. Based on survey results, the Bureau decided that no adjustments would be made.

The Population Division of the Census Bureau also provides population figures for non-census years. Postcensal estimates are computed after a decennial census using the components of population change: births, deaths, and migration. Intercensal estimates refer to population estimates for years between two censuses (e.g., 1991-1999). These estimates are based on data from the two censuses and the original set of postcensal estimates developed during that decade.

Current Population Survey

The Current Population Survey (CPS) is a monthly survey of about 60,000 households representing the civilian non-institutionalized population of the United States. It is conducted by the U.S. Census Bureau for the Bureau of Labor Statistics. The CPS ascertains demographics, employment status, weekly hours worked, and industry and occupation of each household member aged 15 years and older. The inquiry relates to activity or status during the calendar week that includes the 12th day of the month. One of the ways the BLS makes the survey data available is a data analysis program, "DataFerrett," that users can download from the Internet. The occupational and industrial classifications of CPS data for 1992 through 2002 were based on the coding systems used in the 1990 Census. Since then, the CPS has changed its coding systems for occupation and industry. More information can be found at www.census.gov. The CPS undercounts certain racial/ethnic workers who have no permanent address or are migratory in nature. Because CPS estimates are based on a survey rather than a complete census of the population, they are subject to sampling error.

Geographic Profile of Employment and Unemployment

Each year, the BLS produces annual average employment information for census regions, states and metropolitan areas in its "Geographic Profile of Employment and Unemployment" series. Data from the Current Population Survey (described above) are the basis for the information provided on the employed and unemployed by selected demographic and economic characteristics. Starting in 2002, all data for states and regions reflect Census 2000-based population controls (i.e., Census 2000 data were used to adjust the weights applied to sample respondents).

Employment and Earnings

The BLS produces a monthly report on national employment and earnings. This information is compiled from two sources, the Current Population Survey (CPS) and the Current Employment Statistics (CES) survey. The CPS data are described above. The CES survey data are gathered from a sample of employers and provide industry information on employment, average weekly hours, average hourly earnings and average weekly earnings. CPS-based data in the Employment and Earnings report were the source of the national information provided in the Employment Demographics section.

Local Area Unemployment Statistics

The Local Area Unemployment Statistics (LAUS) program is a Federal-State cooperative effort in which monthly estimates of total employment and unemployment are prepared for approximately 7,200 areas including each state. The concepts and definitions underlying LAUS data come from the CPS. State monthly model estimates are controlled in "real time" to sum to national monthly labor force estimates from the CPS. These models combine current and historical data from the CPS, the CES program, and State unemployment insurance (UI) systems.

National Academy of Social Insurance

The National Academy of Social Insurance (NASI) is a non-profit, non-partisan organization dedicated to the study of social insurance programs such as workers' compensation, Medicare, and unemployment insurance. NASI produces an annual research report estimating the annual benefits, coverage, and costs associated with workers' compensation systems at the state level. NASI estimates the number of workers covered by workers' compensation insurance by utilizing state unemployment insurance data. These data are then adjusted for differences in workers' compensation coverage laws with unemployment insurance coverage laws within a state.

References

1. National Academy of Social Insurance. *Workers' Compensation: Benefits, Coverage, and Costs*, 2003. July 2005. Available at:
http://www.nasi.org/usr_doc/NASI_Workers_Comp_Report.pdf.
2. Council of State and Territorial Epidemiologists. *Occupational Health Indicators: A Guide for Tracking Occupational Health Conditions and Their Determinants*. June 2004. Available at:
http://www.cste.org/pdffiles/Revised%20Indicators_12.14.04.pdf.
3. Council of State and Territorial Epidemiologists. *Putting Data to Work: Occupational Health Indicators from Thirteen Pilot States for 2000*. October 2005. Available at:
http://www.cste.org/pdffiles/newpdffiles/CSTE_OHI.pdf.
4. Leigh JP et al. An estimate of the US government's undercount of nonfatal occupational injuries. *Journal of Occupational and Environmental Medicine*. 2004; 46 (No. 1).
5. Conway H, Svenson J. Occupational injury and illness rates, 1992-1996: why they fell. *Monthly Labor Review* 1998; 121(11) 36-58.
6. Azaroff LS, Levenstein C, Wegman DH. Occupational injury and illness surveillance: conceptual filters explain underreporting. *American Journal of Public Health*. 2002; 92(9):1421-1429.
7. Dembe AE, Mastroberti MA, Fox SE, Bigelow C, Banks SM. Inpatient hospital care for work-related injuries and illnesses. *American Journal of Industrial Medicine* 2003; 44:331-342.
8. Sorock GS, Smith E, Hall N. An evaluation of New Jersey's hospital discharge database for surveillance of severe occupational injuries. *American Journal of Industrial Medicine* 1993; 23:427-437.
9. Stanbury M, Reilly M, Rosenman K. Work-related amputations in Michigan, 1997. *American Journal of Industrial Medicine*. 2003;44:359-367.
10. Centers for Disease Control and Prevention. Occupational burns among restaurant workers – Colorado and Minnesota. *Morbidity and Mortality Weekly Report*. 1993; 42:713-716.
11. Baggs J, Curwick C, Silverstein B. Work-related burns in Washington State, 1994-1998. *Journal of Occupational and Environmental Medicine*. 2002; 44:692-699.
12. National Institute for Occupational Safety and Health. *Worker Health Chartbook*, 2004. Cincinnati OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, DHHS (NIOSH) Publication No. 2004-146. 2004. Available at:
<http://www.cdc.gov/niosh/docs/chartbook/pdfs/2004-146.pdf>.

13. Institute of Medicine and National Research Council, *Musculoskeletal Disorders and the Workplace; Low Back and Upper Extremities*. National Academy Press, Washington, D.C. 2001, p. 58.
14. National Institute for Occupational Safety and Health. Musculoskeletal disorders and workplace factors: a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. DHHS (NIOSH) Publication No. 97-141. 1997.
15. Tanaka S, Wild DL, Seligman PJ, Halperin WE, Behrens VJ, Putz-Anderson V. Prevalence and work-relatedness of self-reported carpal tunnel syndrome among U.S. workers: analysis of the occupational health supplement data of the 1988 national health interview survey. *American Journal of Industrial Medicine*. 1995; 27:451-470.
16. Christiani DC, Wegman DH. Respiratory disorders. *Occupational Health: Recognizing and Preventing Work-Related Disease* (3rd ed.) Levy BS, Wegman DH (eds.) Little, Brown, 1995:427-454.
17. National Institute for Occupational Safety and Health. *Work-related lung disease surveillance report 2002*. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. DHHS (NIOSH) Number 2003-111. 2003.
18. Rosenman KD, Reilly MJ, Henneberger PK. Estimating the total number of newly recognized silicosis cases in the United States. *American Journal of Industrial Medicine*. 2003; 44:141-147.
19. Goodwin S, Stanbury M, Wang M-L, Silbergeld E, Parker JE. Previously undetected silicosis in New Jersey decedents. *American Journal of Industrial Medicine*. 2003; 44:304-311.
20. Anderson RN, Minino AM, Hoyert DL, Rosenberg HM. Comparability of cause of death between ICD-9 and ICD-10: preliminary estimates. National vital statistics reports; 49(2). Hyattsville, Maryland: National Center for Health Statistics; 2001. Available at: http://www.cdc.gov/nchs/data/nvsr/nvsr49/nvsr49_02.pdf.
21. Calvert GM, Plate DK, Das R, Rosales R, Shafey O, Thomsen C, Males D, Beckman J, Arvizu E, Lackovic M. Acute occupational pesticide-related illness in the US, 1998-1999: Surveillance findings from the SENSOR-pesticides program. *American Journal of Industrial Medicine*. 2004;45:14-23.
22. Blondell J. Epidemiology of pesticide poisonings in the United States, with special reference to occupational cases. *Journal of Occupational and Environmental Medicine*. 1997;12:209-220.
23. Calvert GM, Mehler LN, Rosales R, Baum L, Thomsen C, Male D, Shafey O, Das R, Lackovic M, Arvizu E. Acute pesticide-related illnesses among working youths, 1988-1999. *American Journal of Public Health*. 2003; 93:605-610.

24. Schwartz A, Stanbury M. *Occupational Pesticide Illness and Injury Surveillance in Michigan June 2001 – December 2003*. Michigan Department of Community Health. Lansing, Michigan. August 2005. Available at: http://www.michigan.gov/documents/Pesticides_Annual_report_2003_finajpeg_127710_7.pdf.
25. Albin M, Magnani C, Krstev S, Rapiti E, Shefer I. Asbestos and cancer: An overview of current trends in Europe. *Environmental Health Perspectives*. 1999; 107(2): 289-298.
26. Price B, Ware A. Mesothelioma trends in the United States: an update based on Surveillance, Epidemiology, and End Results Program data for 1973 through 2003. *American Journal of Epidemiology*. 2004; 159(2): 107-112.
27. U.S. Department of Labor. *Program Highlights; Fact Sheet No. OSHA 92-06, 2004*. Available at: www.pp.okstate.edu/ehs/training/oshasbes.htm.
28. U.S. Department of Health and Human Services. *Healthy People 2010*. 2nd edition. Washington DC. U.S. Government Printing Office. November 2000. Objective 20-7.
29. Rosenman KD, Sims A, Luo Z, Gardiner J. Occurrence of lead-related symptoms below the current Occupational Safety and Health Act allowable blood lead levels. *Journal of Occupational and Environmental Medicine*. 2003; 45:546-555.
30. Schwartz J. Lead, blood pressure and cardiovascular disease in men. *Archives of Environmental Health*. 1995; 50:31-37.
31. Centers for Disease Control and Prevention. *Second National Report on Human Exposure to Environmental Chemicals*. Atlanta, GA: U.S. Department of Health and Human Services. NCEH Pub. No. 03-0022, Lead CAS No. 7439-92-1. 2003. Available at: <http://www.cdc.gov/exposurereport>.
32. Roscoe RJ, Ball W, Curran JJ, et. al. Adult blood lead epidemiology and surveillance – United States, 1998-2001. *Morbidity and Mortality Weekly Report*. December 13, 2002; 51(No. SS11); 1-10.
33. Rosenman K, Sims A, Kalinowski D, Paterson D, Scoblic M, Hudson S. 2002 annual report on blood lead levels in Michigan. A joint report of Michigan State University, Michigan Department of Consumer and Industry Services and Michigan Department of Community Health. East Lansing, Michigan. May 8, 2003. Available at: http://www.oem.msu.edu/Lead/02LeadAnnRpt_all.pdf.
34. Rosenman K, Sims A, Kalinowski D, Paterson D, Scoblic M, Hudson S. 2003 annual report on blood lead levels in Michigan. A joint report of Michigan State University, Michigan Department of Labor and Economic Growth and Michigan Department of Community Health. East Lansing, Michigan. March 4, 2004. Available at: http://www.oem.msu.edu/Lead/03LeadAnnRpt_all.pdf.

35. Rosenman K, Sims A, Kalinowski D, Paterson D, Scoblic M, Hudson S. 2004 annual report on blood lead levels in Michigan. A joint report of Michigan State University, Michigan Department of Labor and Economic Growth and Michigan Department of Community Health. East Lansing, Michigan. May 2, 2005. Available at: http://www.oem.msu.edu/Lead/04Lead_AnnRpt_all.pdf.
36. World Health Organization, *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision. Geneva, Switzerland. 1992. Updated and corrected by the National Center for Health Statistics, October 1998.
37. World Health Organization. *International Classification of Diseases for Oncology*. Geneva, Switzerland. Last updated 2000.
38. Pickle LW, Feuer EJ, Edwards BK. U.S. predicted cancer incidence, 1999: complete maps by county and state from spatial projection models. *NCI Cancer Surveillance Monograph Series*, Number 5. Bethesda, MD: National Cancer Institute, 2003. NIH Publication No. 03-5435.
39. World Health Organization. *International Classification of Diseases*, Ninth Revision, Clinical Modification. Last updated 2003.
40. Watson WA, Litovitz TL, Rodgers GC, et. al. 2002 annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *American Journal of Emergency Medicine*. September 2003; 21:5.
41. World Health Organization. *International Classification of Diseases: Manual on the International Statistical Classification of Diseases, Injuries, and Causes of Death*. (9th Revision). Geneva: WHO, 1977.